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JANUARY • 1956

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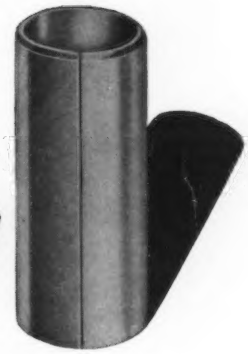

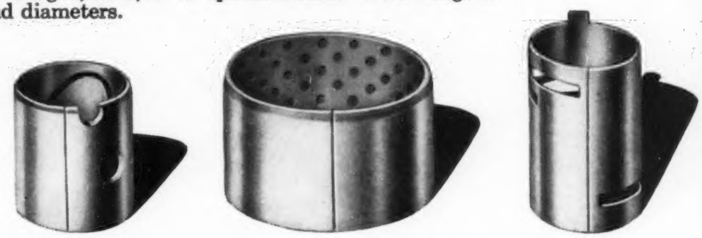

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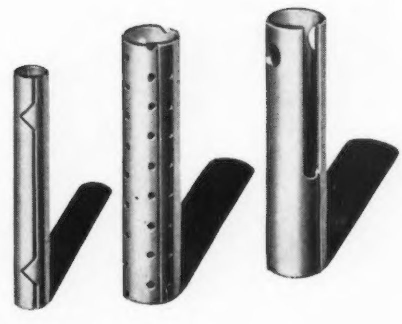

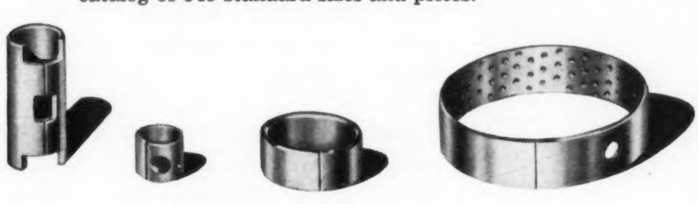

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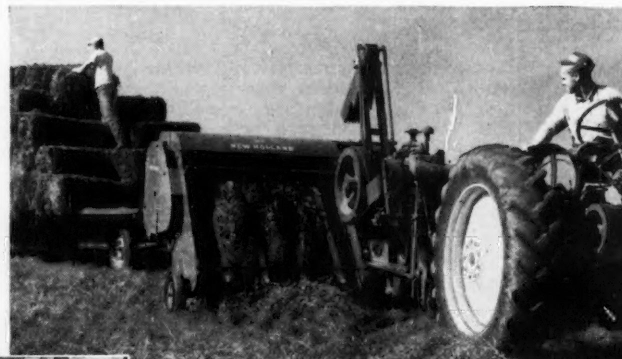

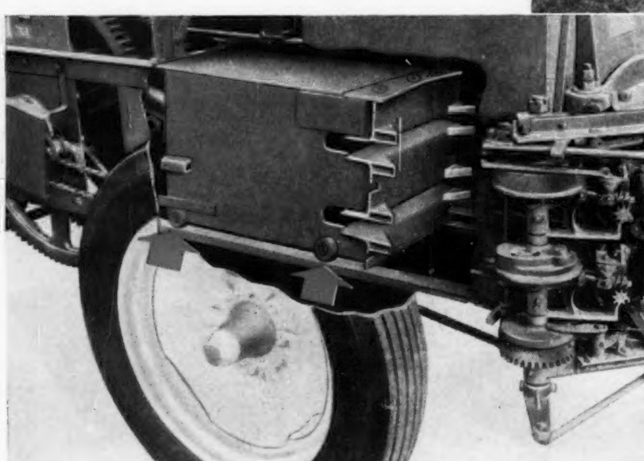

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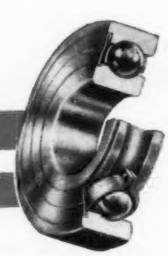

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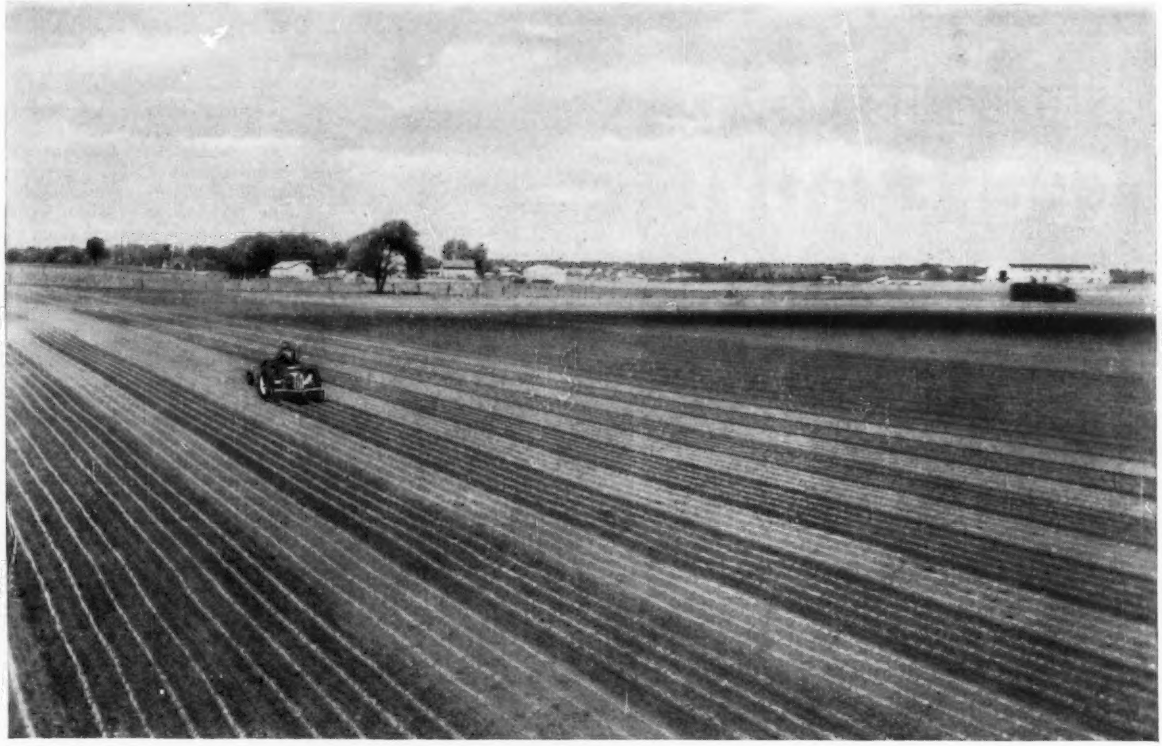
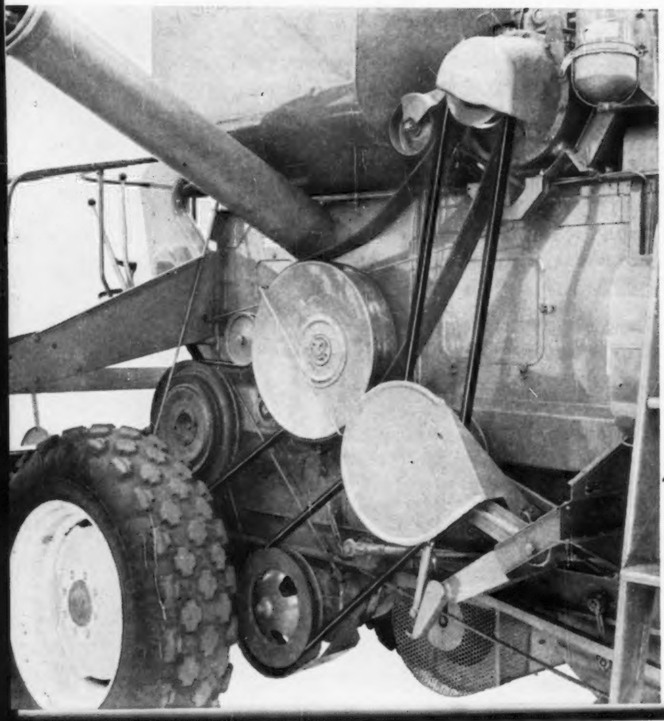


DAYTON V-BELTS

John Deere 45 Combine



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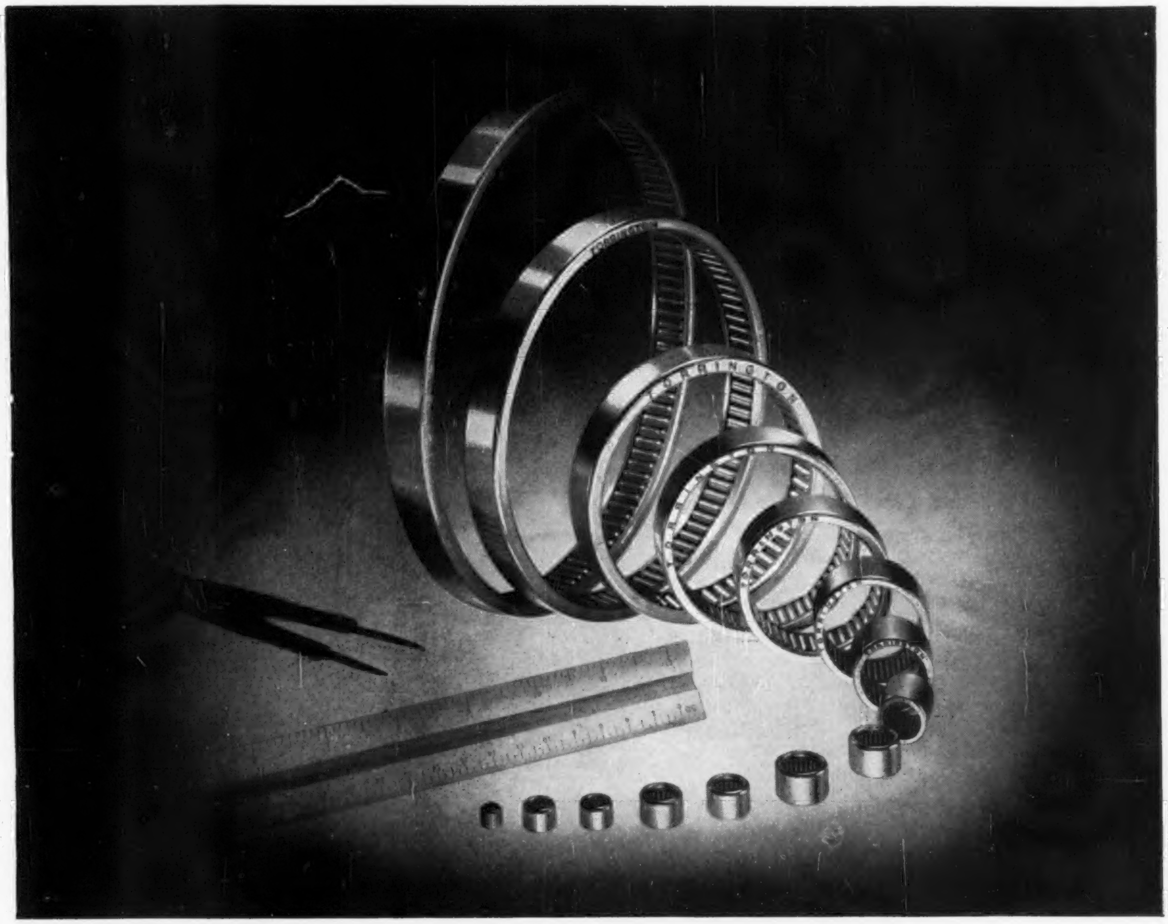

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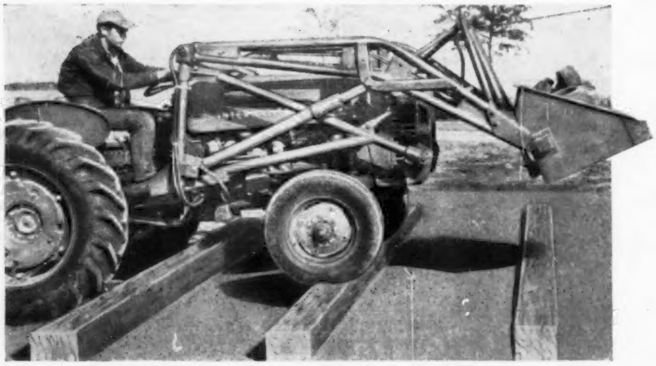

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AGRICULTURAL ENGINEERING

VOL. 37 JANUARY, 1956 No. 1

Analysis of Forage Harvester Design

F. Z. Blevins and H. J. Hansen
Assoc. Member ASAE Member ASAE

A research study aimed at determining the power requirements of various components of the field-type forage harvester revealed definite possibilities for correcting power losses, including frictional drag, material acceleration and the elevating operation

LIKE most machines, the forage harvester has evolved slowly. Stationary silo fillers and ensilage cutters were the first machines used in the preparation of silage. The first ensilage cutters were used about 1876 (1)*; however, feed cutters were used earlier than this. The basic principles of the first ensilage cutters have changed little up to the present-day machines. At the present time there are several machines manufactured for field chopping. Some of them differ in design; however, none are radically different in principle since knives are used to cut the forage.

In this report two basic types of field forage harvesters, each distinguished by its cutting unit, were studied. One has a flywheel cutting unit with knives mounted parallel to the plane of rotation. The other type has a rotary cylindrical reel with knives mounted on the periphery of the reel and the cutting edge is merely perpendicular to the plane of rotation.

Objectives of Study

The amount of useful work and the amount of unnecessary work performed by the forage harvester is rather vague, and there is a possibility that some of the unnecessary work is detrimental to the quality of forage produced.

The object of this investigation was to use new methods for determining the breakdown of power requirements of a field forage harvester under numerous conditions.

In order to get a better understanding of what happens in a forage harvester it was planned to study the path of the forage through the machine. The forage is taken into the machine and is elevated to the entrance of the cutting unit; then it is fed into the machine at a relatively constant speed by the feed rolls. After the forage has been sheared away from the continuous feed, it is accelerated almost instantly to the speed of the knives. Since the knives are traveling in a rotary motion, centrifugal force on the cut material causes it to move radially. The housing which encloses the cutting unit restrains the radial movement and forces the material to move through a semicircle to the discharge tube. From the discharge-tube entrance, the forage moves to wagon or truck by virtue of its kinetic energy and air flow inside the tube.

Each time the forage undergoes a change in direction or speed, a certain amount of power is required to produce this change. The power required by a forage harvester may be divided into the following categories:

- Power required by the feed mechanism
- Power required to cut the forage
- Power required to accelerate the forage
- Power required to move air
- Power required to overcome friction of forage against stationary parts of the machine
- Power required to overcome mechanical friction of moving parts in the machine.

Experimental field tests were set up so that the magnitude of each of the above requirements could be determined.

Testing Procedures

The tests were conducted in the field under conditions which were considered to be average for harvesting forage. Three different commercial machines were used in the tests. Two of the three machines were of the flywheel type. The principal difference in these two machines was the manner in which the knives were mounted. The third machine was

Fig. 1 Forage harvester under field test run in corn

Paper presented at the winter meeting of the American Society of Agricultural Engineers at Chicago, Ill., December, 1954, on a program arranged by the Power and Machinery Division. Authorized for publication as Journal Paper No. 919 of the Purdue Agricultural Experiment Station, project 638.

The authors — F. Z. BLEVINS and H. J. HANSEN—are, respectively, former graduate research assistant and former assistant professor of agricultural engineering, Purdue University.

*Numbers in parentheses refer to the appended references.

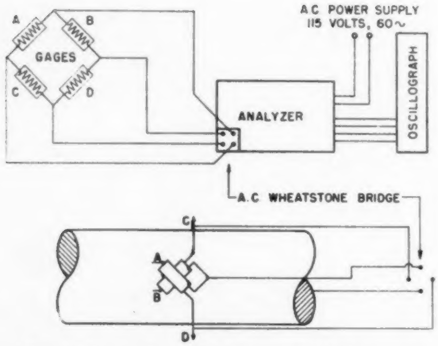

Fig. 2 Wiring diagram for gages and instruments

of the rotary-reel type. (Fig. 1 shows one of the forage harvesters under a field-test run.)

SR-4 electric resistance strain gages were used to sense the torque input to the main and auxiliary drives of the machine (2). Each machine tested was a production model and was equipped with an auxiliary engine which supplied sufficient power for the capacity of the machine. The tests were conducted for the most part in alfalfa of various moisture contents. One flywheel machine was used in corn with a row-crop attachment.

The alfalfa was mowed and cured to the desired moisture content and then it was raked into windrows. The windrows for tests were approximately 100 ft in length. The forage for each test was weighed to determine the rate of harvesting. In some of the tests, the material was caught in a small two-wheeled trailer and weighed after it was chopped. In certain tests it was not convenient to catch the material after it was chopped. For these tests, the forage was weighed before it was chopped.

In order to determine the moisture content of the forage for each test run, a random sample was collected immediately after chopping. The samples were placed in moisture-proof bags and brought into the laboratory for drying to determine their moisture content (wet basis).

The same samples used for determining moisture were used to find the average length of cut. This was accomplished by taking approximately 300 random pieces of forage and laying them end to end. Their total length was then divided by the number of pieces to determine the average length of cut.

The instrument used to record the data was a two-channel recording oscillograph. The oscillograph was interconnected with two matched brush analyzers which were used to amplify the strain-gage impulses.

In order to compensate for temperature change along the shaft due to bearing friction, the strain gages were placed with their grids one on top of the other and major axes 90 deg apart. Bending in the shaft was compensated for by placing the pairs of gages 180 deg apart on the shaft (3). The wiring diagram for the gages is shown in Fig. 2.

In order to determine the horsepower being delivered by a particular shaft, it was essential to know the exact speed of the shaft as well as the torque. This was accomplished by adding a set of breaker points to the mercury collector (4) used to take the strain impulses from the rotating shaft. The points were connected in series with a 6-v storage battery and a solenoid-actuated interval marker on the oscillograph.

For the tests, the instruments were carried on a special instrument carrier in the back of a pickup truck. A small portable a-c generator was used to supply the power to the instruments. The output frequency of the generator was governed closely at 60 cycles per second to assure accurate chart speed and timing.

During the test run, wires were passed from the forage harvester to the instruments in the truck. The truck was driven alongside the machine under tests. The field setup and instrumentation as used in corn is shown in Fig. 1.

Experimental and Analytical Results

For convenience in referring to each test machine, they are designated as follows:

No. I —Cylindrical reel-type cutting unit (Fig. 3)

No. II —Flywheel cutting unit with knives mounted straight (Fig. 4)

No. III—Flywheel cutting unit with knives mounted at 30 deg to plane of rotation (Fig. 5).

The cutting action of unit No. I was similar to a reel-type lawn mower. The forage entered the cutting unit in a wide band. The knives were formed on a helix so that the cutting was a scissor action. Tests on this unit were in

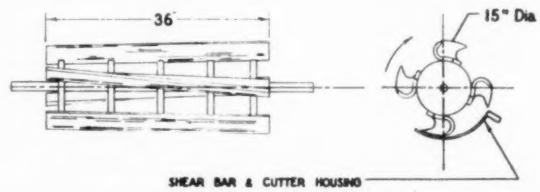

Fig. 3 A line sketch of cutting unit No. I

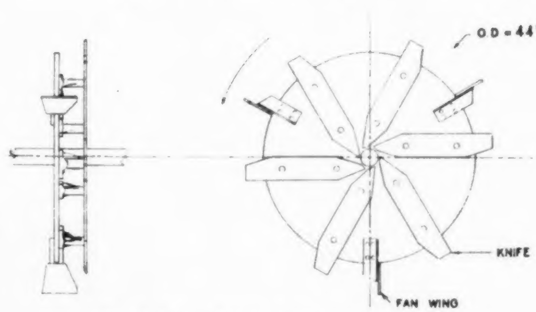

Fig. 4 A line sketch of cutting unit No. II

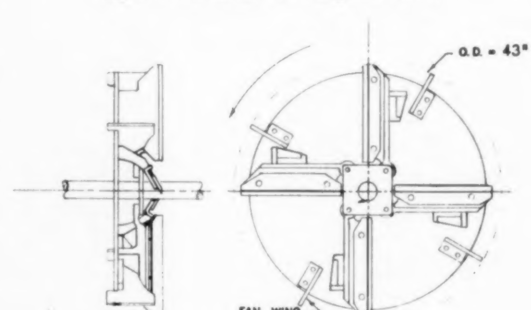

Fig. 5 A line sketch of cutting unit No. III

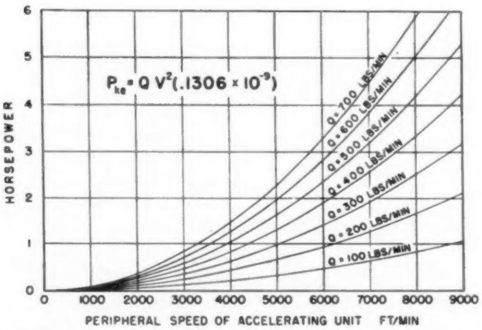

Fig. 6 Horsepower required to accelerate chopped forage

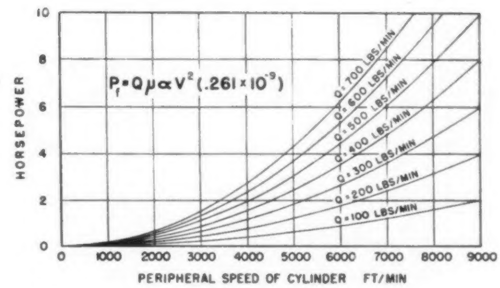

Fig. 7 Friction horsepower loss in unit No. I; machine, Allis-Chalmers; crop, alfalfa, 74 percent moisture; real radius, 7.25 in; $\alpha = 1.57$ radians, and $\mu = 0.6$

alfalfa of approximately 74 percent moisture content. After the forage had been cut, it was partially carried and partially dragged to the discharge tube. The angle of drag for unit No. I was approximately 90 deg. The total horsepower input to the shaft on which the cutting unit was mounted was measured for all the field tests. The total power consumption of the cutting unit was broken into three components as follows: *(a)* power required to cut material and move air, *(b)* power required to overcome friction of material against cutter housing, and *(c)* power required to accelerate cut material.

The components due to friction and acceleration of material must be subtracted from the total recorded power to obtain cutting and air horsepower. By combining experimental data with analytical methods, components *(b)* and *(c)* can be calculated.

For the test conducted on unit No. I, the values for horsepower due to kinetic energy input to the material were calculated. A series of curves calculated for horsepower due to acceleration of material are shown in Fig. 6. This graph shows how horsepower varies with peripheral velocity and rate of material flow. The graph will apply to any machine where V is known.

A series of curves for friction horsepower versus peripheral speed are shown in Fig. 7 for unit No. I. These curves do not apply to any machine other than unit No. I in alfalfa. Values for α and μ are likely to change for different machines and other forages.

Another series of curves for friction horsepower versus peripheral speed for units Nos. II and III are shown on Fig. 8. Values for α and μ were found experimentally and grouped as a constant *(k)* for the calculations which were performed.

The following equations give the friction horsepower and acceleration horsepower, respectively:

$$P_f = Q\mu\alpha V^2 \ (0.261 \times 10^{-9}) \quad [A]$$

$$P_{ke} = QV^2 \ (0.1306 \times 10^{-9}) \quad [B]$$

Following are the derivations of these equations and definitions of terms:

Equation [A] for friction horsepower where

μ = Coefficient of friction
F_n = material force normal to housing, lb
R = radius of housing in feet
ω = radians per second
N = rpm of cutter
W = total weight of material against housing at any instant, lb
α = angle in radians material is in contact with housing
Q = rate of flow of material in pounds per minute
P_f = friction horsepower.

Then $P_f = \mu F_n R \ (2\pi)N/33{,}000 \quad [1]$

$$F_n = (W/g)\ R\omega^2$$

$$F_n = (W/g)R\ (2\pi N/60)^2$$

$$F_n = 0.00034\ WRN^2 \quad [2]$$

W in terms of rate Q is

$$W = QR\alpha/2\pi\ RN = Q\,\alpha/2\pi\ N$$

Making the substitution for W in equation [2]

$$F_n = 0.00034\ (Q\alpha RN/2\pi)$$

Substituting this expression equation [1] gives

$$P_f = \alpha\ QR^2N^2\ \mu(1.0303 \times 10^{-8}) \quad [3]$$

Further simplification can be accomplished by setting $V = 2\pi\ RN$.

Then $RN = V/2\pi$

or $R^2N^2 = V^2/(2\pi)^2$

Substituting in equation [3] gives

$$P_f = Q\alpha\,\mu\,V^2\ (0.261 \times 10^{-9}) \quad [A]$$

Equation [B] for acceleration horsepower

Let E_k = kinetic energy imparted to material
v = velocity in feet per second
t = time in minutes
P_{ke} = power required to accelerate material (initial velocity of material is assumed to be zero.)

Other terms have the same definition as in equation [A].

$$E_k = Wv^2/2\ g$$

$$P_{ke} = (E_k/t)/33{,}000$$

$$W/t = Q$$

$$E_k/t = Wv^2/2gt = Qv^2/2g$$

$$v = 2\pi\ RN/60$$

Finally $P_{ke} = Q(2\pi\ RN/60)^2/2g\ (33{,}000)$

$$P_{ke} = QR^2N^2\ (0.5152 \times 10^{-8}) \quad [4]$$

Making a substitution for R^2N^2 gives

$$P_{ke} = QV^2\ (0.1306 \times 10^{-9}) \quad [B]$$

Equations [A] and [B] can be used to compute the power for any forage-harvester cutting unit as long as the values are interpreted correctly.

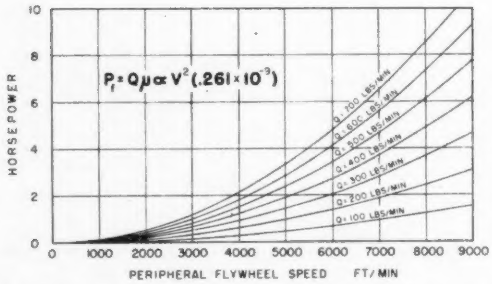

Fig. 8 Friction horsepower loss in units Nos. II and III; machines, Gehl and Case; crop, alfalfa; 74 percent moisture, and $\mu\alpha = k =$ 0.732 (experimental)

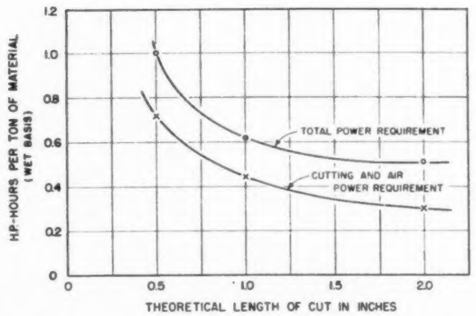

Fig. 9 Power requirements versus length of cut for unit No. I in alfalfa, 74 percent moisture, at normal operating speed range

Fig. 9 shows the power requirements versus length of cut for unit No. I. The air horsepower required for any fan unit is proportional to the cube of the fan speed. Fan action on unit No. I accounted for approximately ½ hp at ½-in cut and a normal operating speed of 1400 rpm. Air power requirements are negligible for unit No. I at speeds lower than 1400 rpm.

Tests on Unit No. II

Unit No. II was a flywheel-type machine which had knives mounted approximately parallel to the plane of rotation. The average operating speed of this unit was 600 rpm (manufacturer's rating). Length of cut was changed by adding knives or varying pickup speed. The total horse-

The equation of motion can be expressed as follows:

$$F = F_o + kr \qquad [5]$$

Where F = force at displacement r (Fig. 12)

F_o = force at $r = 0$; r_i is the center of rotation.

Therefore, $F_o = 0$

k = slope of curve

r = displacement

Finally, since $F_o = 0$

$$F = kr$$

Also $F = Mr\omega^2$

Substituting

$$kr = Mr\omega^2$$

Then $k = M\omega^2$

Using the relationship

$$F = Ma \qquad [6]$$

$$kr = Ma \qquad [7]$$

Since $k = M\omega^2$

$$M\omega^2 r = Ma \qquad [8]$$

The mass drops out; therefore, the time required for a particle to move from cutoff position to the flywheel rim is independent of the mass if gravity, friction, and air resistance are neglected. If equation [8] is further simplified,

$$\omega^2 r = a$$

$$a = d^2r/dt^2 = \omega^2 r$$

$$d^2r/dt^2 = dv/dt = dr\ dv/dt\ dr = v(dv/dr)$$

$$\omega^2 r = v(dv/dr)$$

Integrating this

$$\omega^2 r^2/2 = v^2/2 + C_1 \qquad [9]$$

Since $v = dr/dt$

$$\omega^2 r^2/2 = \tfrac{1}{2}(dr/dt)^2 + C_1$$

Solving for dt

$$dt = \sqrt{1/\omega^2}\ [dr/\sqrt{r^2 - 2C_1/\omega^2}]$$

Let Θ equal angular displacement of flywheel while particle is moving from cutoff position, r_i, to the outside of the flywheel, r_o. (Refer to Fig. 12).

Then $\Theta = \int \omega\, dt$

Substituting for dt gives

$$\Theta = \int_{r_i}^{r_o} dr/\sqrt{r^2 - (2C_1/\omega^2)} \qquad [10]$$

C_1 is a constant determined by equation [9] and depends on where the particle is cut off with relationship to the center of rotation. Solving for C_1 from equation [9] gives

$$C_1 = \omega^2 r^2/2 - v^2/2$$

Let r_i be point of cutoff.

v_o = velocity of particle radially at cutoff. This is always zero. Therefore

$$C_1 = \omega^2 r_i^2/2$$

Substituting in equation [10] gives

$$\Theta = \int_{r_i}^{r_o} dr/\sqrt{r^2 - r_i^2} \qquad [11]$$

This shows that the speed of rotation has no effect on angular displacement required for the particle to move from r_i to r_o.

$$\Theta = \ln\left[r + \sqrt{r^2 - r_i^2} \right]_{r_i}^{r_o}$$

$$\Theta = \ln\left[(r_o + \sqrt{r_o^2 - r_i^2})/r_i \right] \qquad [12]$$

where Θ is in radians and r is in feet.

The alternate integral formula may also be used conveniently since values for the hyperbolic cosine can be obtained directly from mathematical tables. The alternate form is as follows:

$$\Theta = \cosh^{-1} r_o/r_i - \cosh^{-1} 1 \qquad [12a]$$

$$\cosh \Theta = r_o/r_i$$

$$r_o = r_i \cosh \Theta$$

The previous proof shows that the angle of contact (α) between the forage and the cutter housing in any forage harvester is independent of cutter speed or specific gravity of material being cut. Since the angle is determined by the dimensions of the machine, it is constant for a given machine.

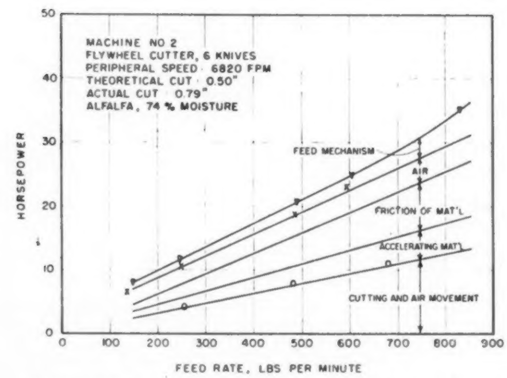

Fig. 10 Division of horsepower requirements for unit No. II

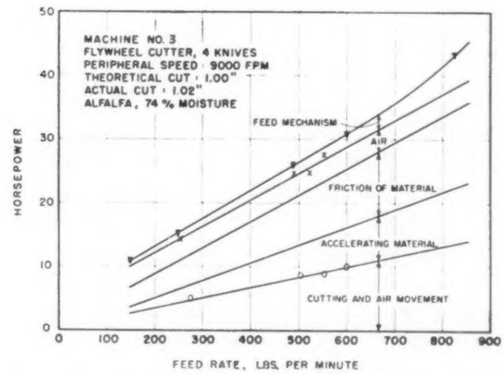

Fig. 11 Division of horsepower requirements for unit No. III

power required by this unit was recorded in a manner similar to that described for unit No. I.

The component of friction horsepower was eliminated from one complete series of tests by removing the fan housing and permitting the cut material to flow directly on the ground. The fan wings were removed for these tests also to reduce air movement and kinetic energy input to the cut material. The forage material was weighed prior to chopping for these tests. Horsepower due to kinetic energy input to the material was calculated by using equation [B] and making the assumption that all the cut material was accelerated to the peripherical speed of the outermost knife mounting. There is a possibility that some of the forage cut near the center of rotation never touched the outside knife mounting on its outward travel; however, some of the material cut outside the outer knife mounting is probably accelerated more than the assumed condition. These factors would seem to nullify each other.

Fig. 10 shows division of horsepower requirement for unit No. II at a theoretical cut of ½ in. From this figure the friction horsepower is known because it was isolated in the tests by merely removing the fan housing on the machine. The known values for friction horsepower may be taken from Fig. 8 and substituted into equation [A]. When this is done, α and μ are the only unknown quantities in equation [A]. α represents the angle over which the forage inside the cutter housing would extend, if it were evenly distributed at any instant of operation. μ represents the coefficient of friction of material against the housing. α is constant for a given machine regardless of speed. (This will be proven later.) μ is a constant for given material; therefore, $\alpha\,\mu$ is a constant *(k)* which may be calculated.

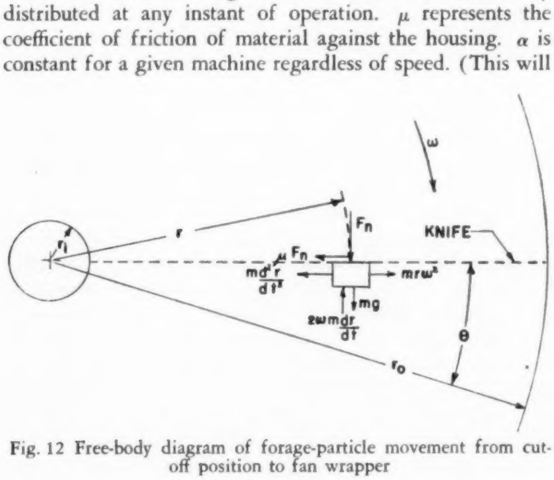

Fig. 12 Free-body diagram of forage-particle movement from cut-off position to fan wrapper

Tests on Unit No. III

Unit No. III was a flywheel machine with knives mounted at an angle of 30 deg to the plane of rotation. A maximum of four knives were used on this machine. The length of cut was varied by operating the flywheel at two different cutting speeds, 550 and 850 rpm. Variation in length of cut could also be obtained by changing the speed of the feed attachment or by removing two knives from the cutting unit.

The testing procedure for this unit was similar to unit No. II; however, more tests were conducted with this machine. A division of power requirements for unit No. III at a theoretical cut of 1 in is shown in Fig. 11.

Analysis of Particle Movement Inside a Forage Harvester

The frictional force and air resistance of the particles inside the forage harvester are not exactly known. Therefore, the actual theoretical time for a particle to move from cutoff position to the flywheel rim cannot be calculated. However, if these factors and gravity are neglected and the particle is assumed to be subjected only to centrifugal force, then what should be a minimum time can be calculated. This will give the worst condition as the material will be in contact with the housing for the greatest distance. First, the radial force-displacement curve is a straight line since the centrifugal force varies only with the radius of the flywheel for a constant angular velocity.

Coefficient of Friction

The coefficient of friction between alfalfa and steel was determined experimentally for different lengths of cut and various moisture contents. No significant effect was noted by varying the length of cut. Moisture content affected the coefficient of friction as shown in Fig. 13. This curve closely resembles the characteristic curve showing the effect of soil moisture upon the coefficient of friction of soil on steel (5).

Tests on corn showed that the coefficient of friction for a moisture content of 70 percent was approximately 0.400, or somewhat lower than alfalfa. This might be expected since the pieces of chopped corn are larger, thus having less surface contact and a lower affinity for steel.

The tests were conducted by placing a known normal force on the chopped material and determining the required

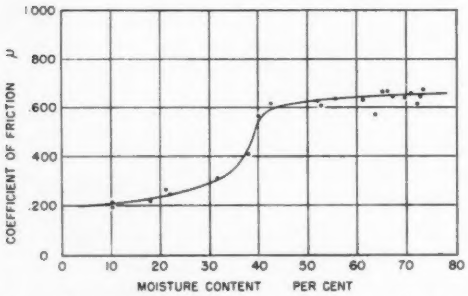

Fig. 13 Coefficient of friction versus moisture content for alfalfa on standard polish stainless steel

moving force. This method gave the coefficient of kinetic friction.

Feed Mechanism

The windrow pickup was tested in alfalfa of 74 percent moisture at various rates of material flow. The total power required to operate the components of the windrow pickup attachment were measured in total and not broken down. The tests were made in conjunction with cutting unit No. II. It was found that the power requirement for the pickup attachment is not excessive except when overloaded. For high rates of material the power required by the unit tends to increase as an exponential function. This is caused by the wedging action of the material against the sides of the feed opening. This wedging action occurs when the feed rolls are fully opened and the material is being compressed to a rather high density. It was also found that there is very little increase in feed mechanism horsepower requirement due to interference from additional knives. Additional knives on the cutting unit tend to decrease the throat opening through which the forage must pass in order to be cut. The increase in power when going from two knives to six knives is approximately ½ hp on unit No. II (Fig. 14).

The row-crop attachment was tested in corn in conjunction with unit No. III. Rates of feeding above 400 lb per min. were not possible with the unit tested as the pickup would not feed properly at higher rates due to speed combinations available. The over-all feed mechanism horsepower required by this unit appeared to be comparable to, but slightly lower than, the windrow pickup at the same rate of material movement. No indication as to what happens at rates comparable to the capacity of the cutting unit were obtained from these tests.

Summary of Results

1 Feed mechanisms do not require excessive power except when overloaded and when the material begins to wedge. The feed mechanism power requirement varies primarily with rate of feeding and is not affected by length of cut.

2 Assuming a constant rate of material flow, power requirements for cutting vary (in the order of importance) with the length of cut, moisture content of material, type of material, speed of knife travel (within operating ranges of tests conducted) and angle of knife blade approach to the material. Approximately 40 percent of the total horsepower required to operate the machine is consumed in cutting when the length of cut is short.

3 Power requirements due to acceleration of material are proportional to the rate of material flow and velocity squared. These requirements become excessive as the peripheral speed of the cutting head is increased.

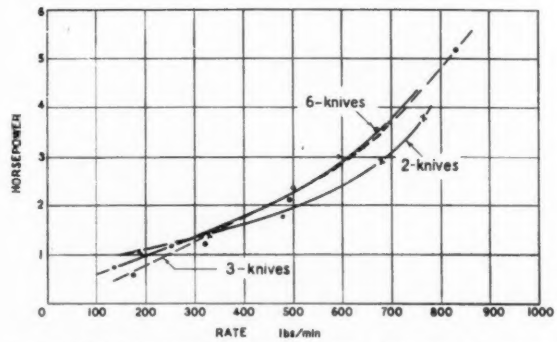

Fig. 14 Feed-table horsepower requirements of the windrow pickup. Machine is Gehl in alfalfa at 74 percent moisture

4 Power requirements due to friction loss on the fan housing are proportional to the square of the velocity and are also affected by moisture content of the material and the rate of material flow.

5 Power required to move air is proportional to the size and number of fan blades and the cube of the fan speed.

6 Coefficient of friction between alfalfa and steel varies with moisture content, ranging from 0.2 at low moisture contents to 0.7 at moisture contents above 50 percent.

Conclusions and Recommendations

The study showed that the power required to chop forage depends primarily upon the type of forage and rate of chopping and therefore cannot be altered by the designer to any great extent.

For a more efficient design, the designer must attack other power-consuming components over which he has some control. The type of cutting unit indirectly affects other power requirements of the over-all machine. All three machines studied showed an excessive loss of power in overcoming frictional drag of forage material in the machine. Actually the friction losses are probably harmful to forage quality. Accelerating the material to a high velocity, either during or after cutting, consumes power proportional to the square of the terminal velocity. The ideal design for a forage harvesting machine would be to cut the material and discharge it instantly from the cutting unit, allowing no time for frictional drag or excessive velocity increases.

The elevating mechanism used by most types of forage harvesters is inefficient. The power requirements of a blower are proportional to the velocity cubed. Therefore, the power requirements for moving air become excessively high on some types of machines on which cutter speeds are increased in order to change the lengths of cut.

In view of the power requirements for frictional drag, material acceleration, and elevating, it seems logical that the cutting and elevating mechanisms could be separated. After the material leaves the cutting unit, it could be elevated by some efficient elevating unit. Such a design would provide greater versatility and the efficiency or capacity of a unit of this type would not be affected by cutter speed as is the case with present design. Furthermore, it would be possible to regulate the length of cut of a forage harvester without affecting capacity. In order to do this without increasing the power requirements for elevating material, the cutting unit

(Continued on Page 29)

Non-Circular Orifices for Sprinkler Irrigation

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Triangular-shaped sprinkler orifices have been the subject of research study in an attempt to improve water distribution of sprinklers and to provide uniform droplet size

A STUDY of the behavior of jets issuing from non-circular orifices(1)* would indicate the possibility of developing a practical means of controlling the disintegration of the jet. The objectives which might be attained include more uniform droplet sizes and a more desirable distribution of water from the sprinkler. The circular nozzle used in agricultural sprinklers by itself is a fairly efficient means of concentrating the water from the jet at or near the maximum radius. Since this is not satisfactory for water distribution, it has been found necessary to interrupt the jet by deflecting surfaces, pins etc., until a fairly satisfactory distribution pattern is obtained. All of these devices utilize the momentum of the water to effect the breakup of the jet into particles by changing the magnitude, the direction, or both, of the momentum of various portions of the jet.

A characteristic of non-circular sharp-edged orifices is that the direction of the momentum is changed without changing the magnitude. Hence it might be expected that their performance as sprinklers would depend more upon the shape of the orifice (which determines direction) and less upon the pressure (which determines the magnitude). It was with these possibilities in mind that a study of the behavior of jets from triangular orifices was begun to determine their suitability for sprinkler use.

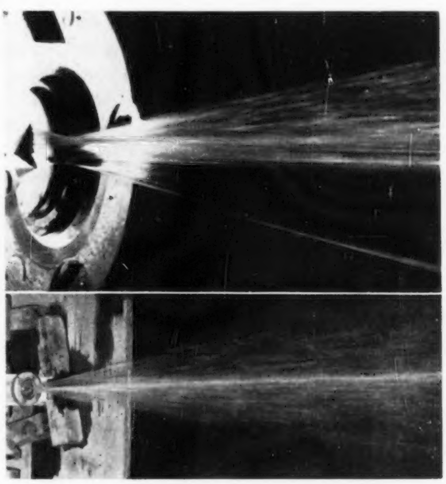

Fig. 1 *(Top)* Jet from a 1 to 1 (height to base) isosceles triangular orifice. Fig. 2 *(Bottom)* Disintegration of a jet from a triangular orifice. The point where attenuation ceases and breakup occurs is identified by the slight change in dispersion angle

Behavior of Jets from Non-Symmetrical Orifices

Figs. 1 and 2 are views of the jet produced by an orifice in the shape of an isosceles triangle. The height-to-base ratio of this orifice is 1 to 1. From observations on this and other orifices with height-to-base ratios of 2 to 1, 3 to 1, 4 to 1, 5 to 1 and a slit, the following observations were made:

- From the vertex of each angle a flat surface appears which may be described as generated by a straight line oriented parallel to the plane of the orifice, at the same time making equal angles with the sides of the angle. The width of these surfaces increases until they become the dominant faces of the jet. (Fig. 1).
- Where these flats meet, thin fins of fluid are formed, three in number, each of which lies opposite a corner and approximately in the plane of a bisector of the angle of the opposite corner. The fins are composed of fluid which is expanding because of the differences in direction of motion of the individual elements. Thus they are broken down rapidly into droplets by attenuation. The droplets appear to be fairly uniform within each fin. Some differences in drop size are observed between fins, especially in jets from the elongated orifices. The slit produces only two fins in the same plane at right angles to the slit.
- The fin opposite the most remote corner contains the most fluid and has the largest droplets.
- Increase in pressure did not greatly affect the appearance of the jet nor, in the absence of air movement, the distribution of water therefrom. Increased pressure did result in much smaller droplet sizes in all fins. With nozzles of the size used in these tests, pressures of 40 psi produced drops too fine for use under normal sprinkling conditions.

The effect of pressure on the drop size may be explained qualitatively by the differences in the time scale of the pressure force-axial inertia system and the surface tension force-transverse inertia system. The absolute time required in the latter system to accelerate the fluid from a flat-shaped element into a sphere of a given size is the same regardless of how fast the fluid is moving. The rate attenuation or reduction in thickness of the sheet before it breaks finally into drops, depends only on the magnitude of the velocity for a given orifice shape. Since pressure controls magnitude of velocity, pressure also controls the amount of attenuation which can occur while surface-tension forces are drawing elements of the fluid into spherical drops. Higher pressures give greater attenuation hence smaller drops.

The results of these preliminary observations were highly encouraging except for the limitations on pressure. Changes in the height-to-base ratio were observed to produce visible shifts in the distribution of water inward or outward without greatly affecting the range of the jet and without producing any noticeable breaks in the continuity of the distribution. Accordingly tests were made to compare the various distributions obtained with the ideal distribution for

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*Numbers in parentheses refer to the appended references.

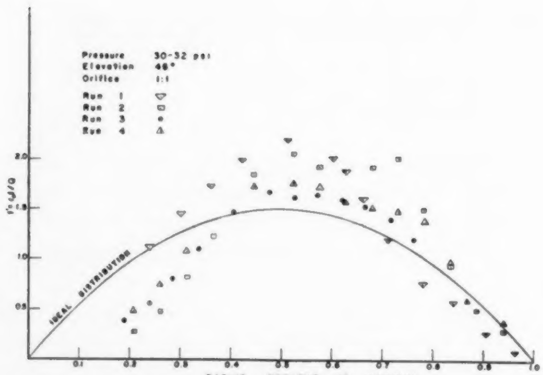

Fig. 3 Comparison of the ideal distribution of water as a function of radius with that observed for a triangular orifice of 1 to 1 (height to base). Runs were two minutes each

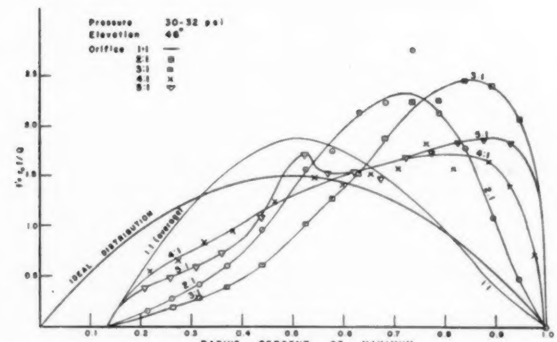

Fig. 4 Comparison of the radial distribution of water from triangular orifices with different height to base ratios. All tests were made with the vertex of the triangle pointing down

rotating sprinklers under conditions of 100 percent overlap (2). The ideal distribution function in terms of volume of rainfall per unit area per unit time (e.g., inches per hour) would appear to be a right circular cone with center at the sprinkler head. For convenience in testing this may be related to the equivalent distribution function expressed as volume per unit *radius* per unit time (e.g., square inches per hour).

Let y be the ideal rate of application of an area basin with units of volume per unit area per unit time. Then $y(r)$ is a straight line passing through the points $(0, y_c)$ and $(r_o, 0)$ where y_c is the range of application at the center and r_o is the maximum radius of the jet.

$$y=y_c\ (1-r/r_o) \qquad [1]$$

Let f be the ideal rate of application on a radius basis with units of volume per unit radius per unit time. This rate is numerically equal to the sum of all the water which should fall on an annular ring of unit width at radius r. Because of the symmetry of the ideal distribution the rate per unit of area y at any given radius is a constant, the desired function is equal to the product of y by the area per unit radius.

$$f=2\ \pi\ ry \qquad [2]$$

Substituting from equation [1]

$$f=2\ \pi\ y_c\ r(1-r/r_o) \qquad [3]$$

The total discharge, Q, is obtained by integration of equation [3] over the radius

$$Q=\pi\ yc\ r_o^{2/3} \qquad [4]$$

In order to be able to compare the form of the distribution from orifices of different rates of discharge, maximum radius, etc., dimensionless rates of application will be introduced. Set $r'=r/r_o$, $y'=y/y_c$ and $f'=r_o f/Q$. Equation [3] becomes

$$f'=6r'\ (1-r') \qquad [5]$$

Equation [5] defines the dimensionless ideal distribution f' as a function of the percent of total radius r'.

Experimental Results

Five triangular orifices of approximately equal areas were tested with height-to-base ratios of 1 to 1, 2 to 1, 3 to 1, 4 to 1, and 5 to 1, respectively. They were cut from 0.015-in sheet brass and were held in a special ring clamp mounted on a flange at the end of a 2-in-diam pipe. Both pressure and angle of elevations were varied. The effect of pressure as noted previously served to increase susceptibility to wind drift.

One defect noted was the practically zero rainfall over approximately the first one-fourth of the radius. This represents one-sixteenth or about 6 percent of the total area. It may be possible that the eventual water-powered driving mechanism can supply this deficiency. Accordingly, the results are plotted in Figs. 3 and 4 as though the total discharge from the nozzle were greater by an amount equal to the ideal discharge required for the first one-fourth of the radius. The correction factor can be obtained by determining the fraction of the total discharge which falls on the outer three-fourths of the radius. By integration of equation [5], the value of this correction factor is $^{27}\!/_{32}$. Each experimental distribution rate was therefore multiplied by $^{27}\!/_{32}$.

Fig. 3 gives an indication of the variability of the distribution between runs. Each observation was made in a period of two minutes. Most of the differences can be ascribed to variations in magnitude and direction of the air movement which would tend to average out over a larger period of time. The 1 to 1 orifice is represented in Fig. 4 by the average of the runs shown of Fig. 3. Fig. 4 shows that considerable variation in distribution can be produced by changing the height-to-base ratio of the triangle. As this ratio is increased, the first effect seems to be to place a greater quantity of water at larger radii. After 3 to 1 is reached, the amount of water caught earlier increases. This is probably due to the creation of finer droplets as the width of the orifice becomes the controlling dimension for dynamic similarity. The reverse trend does not continue. The slit orifice was observed to place nearly all the water near the maximum radius.

Maximum range varied with pressure, elevation and shape, being just over 60 ft for the 1 to 1 orifice, 46 deg elevation and 30 psi pressure. Higher pressures did not increase range appreciably but resulted in a much greater susceptibility to wind. Lower elevations and pressures both reduced the effective radius. Orifice dimensions would also affect the range and size of particles produced. The orifice dimensions used could not be considered satisfactory under breezy conditions because of the size of droplets produced.

must be separate and apart from the elevating mechanism. Droplets from the 1 to 1 orifice appeared to be fairly uniform in size.

Summary and Conclusions

Non-circular, sharp-edged orifices would appear to offer sufficient promise for sprinkling to warrant further investigation. Additional problems exist and considerable research will be necessary before practical sprinklers utilizing non-circular orifices can be produced. The principal disadvantage to appear in preliminary tests is susceptibility to wind drift. This disadvantage is accentuated by increasing pressure. This same disadvantage exists in commercial sprinklers to a lesser degree. The much greater uniformity of drop sizes and the ability to control distribution by the orifice shape, on the other hand, give considerable potential value. Not to be forgotten is the possibility of controlling drop size both as to uniformity and average dimension since the differential effects of pressure and shape are readily distinguishable. Uniform moderate drop sizes will help eliminate splash, puddling and other mechanical actions which break down soil structure and lower infiltration rates. The experimental distributions from the orifices also show that the ideal distribution can be approximated.

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Analysis of Forage Harvester Design

(Continued from page 26)

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Helicopter Spraying

THE helicopter is proving its worth as an agricultural spray machine for the small-acreage tobacco farmer as well as the 1,000-acre planter.

Jack Reynolds of Candor, N.C., who has sprayed crops from Maine to Florida in all types of aircraft, hit an all-time high for tobacco by spraying 425 acres in one day with a Bell helicopter. This was 20 acres more than his previous record for tobacco with fixed-wing aircraft, and was accomplished in areas of small plots averaging 4½ acres per customer.

The helicopter has a 75-gal spray capacity and is well adapted for spraying in areas where tobacco is planted in small tree-lined plots. Airplane spraying is extremely hazardous under these conditions, and because of the trees the chemical spray would be dispensed by airplane at tree-top height and left to fall as best it can on the crops below.

Because the helicopter can fly in any direction from 1 to 90 mph, or stand still when necessary, the spray can be applied one foot above the crop and the strong rotor blade downwash is said to force the chemicals through the leaves to the ground where it boils upward to cover the hard-to-reach underside of the plants.

The maneuverability of the helicopter enables the pilot to apply chemicals evenly, even on tight, tree-lined tobacco fields. Constant control of the chemicals makes it possible to use high concentrations of the poisons with no danger of injury or damage to adjacent lands.

Mr. Reynolds keeps his helicopter spraying ten months out of the year. Following a brief respite from November through December, he begins a heavy agricultural spraying schedule January 15, when it is time to spray insecticides and fungicides on cabbages and potatoes. The months of February through May are devoted to potato crops along the eastern seaboard, alternating with insecticides, fungicides and fertilizer.

Peaches are ready for insect control in June, with tobacco beginning the end of the month and continuing through August. Cotton winds up the season with two months work of insecticide and defoliation spray work.

Cotton defoliation enables the farmer to partially control his picking time, and take advantage of mechanical pickers. Two to three days after spraying the foliage drops off the plants, leaving the cotton exposed on the now-bare bush. On one operation last year in the Carolinas, Reynolds defoliated 465 acres in one afternoon.

Tile Flow Characteristics

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Assoc. Member ASAE

FARMING in the old lake bed area of Ohio has been developed through the use of extensive open ditch and tile drainage systems. To develop better design criteria for the soils and crops of the area a drainage project was initiated and installed during 1948 and 1949 through the cooperation of the Soil and Water Conservation Branch, U. S. Department of Agriculture, the Ohio Department of Mental Hygiene and Correction, and the Ohio Agricultural Experiment Station. The objectives are implied by the project title, "Interrelationships of Crop Rotations, Organic Matter Input, Soil Structural Conditions and the Internal Drainage Characteristics of Soils."

The installation is located just within the limits of a previous lake bed at Tiffin, Ohio. The soil is classified as Nappanee silt loam and the top soil extends to a depth of 8 to 12 in (Fig. 1). The *B* horizon has an increase in fine clay from 3 to 10 percent by volume. Stratified material appears in the *C* horizon below 50 in, mostly as sand lens with sufficient silt and clay to prevent increased permeability.

All tile depths in the study are within the *B* horizon where the aeration porosity, defined by the 60-cm-tension porosity, is approximately constant at 4 percent by volume. This porosity decreases to 3 percent in the *C* horizon, below 50 in.

Procedure

The field layout is arranged in a split-plot system with the crop occupying the whole plot and the tile depths and spacings lying within the plot, normally referred to as fields. The field is repeated so that each crop appears each year. In this sense, there are no true replications as each field represents a different crop or part of a different rotation. A rotation of corn, small grain (oats), and two years of meadow occupies four fields representing high organic levels plus additions of manure; a rotation of corn and small grain (oats) completes the system giving a soil depleting practice. Each field comprises approximately 9 acres and is operated as a farming unit. The system is repeated in an untiled area using approximately one-fourth acre as a comparative field.

The tillage practices are common for all experimental tile within a field as well as the seeding and fertilizer rates. Between fields where moisture differences exist a variable date of preparation and planting may occur, particularly with the untiled area.

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Acknowledgment: The author acknowledges the assistance of G. S. Taylor, soil physicist, co-project leader, Ohio Agricultural Experiment Station, Wooster.

Many controllable factors within a given tile field layout, such as tile depth and spacing and crop cover, are important in tile-flow performance. This paper reports a study of these factors and their effect upon tile flow

Fertilizer rates are high, and identical, except the four-year rotation is given 10 tons per acre of manure and 600 lb per acre of 0-20-20 fertilizer (surface application on meadow) over that applied to the two-year rotation.

Four combinations of tile depths and spacings are used in each field, namely, 2 and 3-ft depths and 30 and 60-ft spacings.

Average depth	Spacing	Code
3 ft	30 ft	DN*
2 ft	30 ft	SN
3 ft	60 ft	DW
2 ft	60 ft	SW

*First letter indicates tile depth; second letter tile spacing. D is deep, S is shallow, N is narrow, and W is wide.

Each experimental line is separated by one buffer line where only a spacing variable is involved, and by two or more lines where two depths are adjacent. Tile effluent is measured by having a 1-ft elevation drop over a 30-deg notch with an FW-1 stage recorder. The resulting graphs of head are converted to flow by the relationship, $Q = .67H^{2.58}$.

Discussion

The recordings of tile flow have been made on 7-day charts which cannot be read closer than 15 min. In addition, under very high intensity rainfall the tile mains flood for short periods (a few hours maximum) which invalidates the data. It is felt that estimates of flow, for these short periods, can be made from comparable data to be used with flow accumulations only.

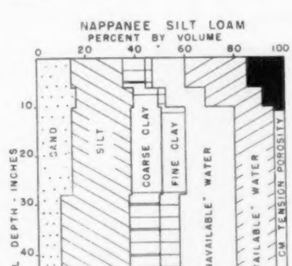

Fig. 1 Predominant textural and water-holding characteristics of soil

The tile flow during fall is erratic and of short duration until the soil moisture has been replenished to a saturated condition continuously throughout the soil mass. The response of flow to rainfall is delayed when the ground is frozen, and when soil moisture is below the free water level. Most other conditions give immediate response to rainfall as indicated in Figs. 2 and 3. Time intervals have been difficult to evaluate because of the scale of measurements and the immediate response obtained.

Fig. 2 shows a sustained flow resulting from a variable, low-intensity rainfall (0.08 in per hr approximately for the initial period) causing increased tile flow, and is characteristic of the flow during the wet season, January through April. The

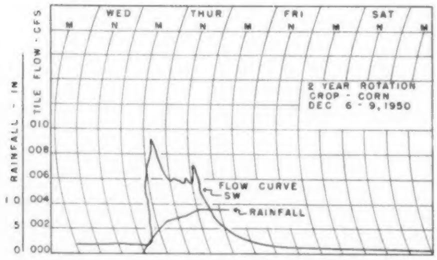

Fig. 2 Low-intensity rainfall and corresponding tile flow

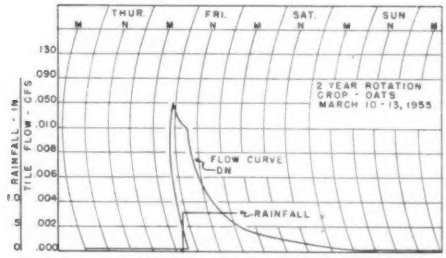

Fig. 3 High-intensity rainfall and corresponding tile flow

tile flow for long periods, of a month or more, without stopping with the rates of flow reflecting each storm period.

Uniform intensity rainfall (.25 iph) and its corresponding flow is shown in Fig. 3. Variation of time between tile design of starting flow and peak flow is not more than ½ hr and the delay of flow from starting rainfall is not more than 1 hr. This general type of curve results from short-period rainfalls except where freezing conditions interfere. These two curves are shown as examples of two general types of storm periods, and the resulting flows, which is the basis for the data and following discussion of rate of change of tile flow by depth and spacing:

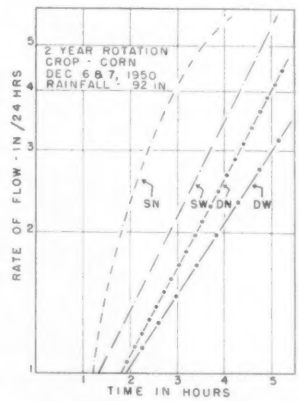

Fig. 4 Effect of tile depth and spacing and rate of increase of tile flow referenced to the time flow started

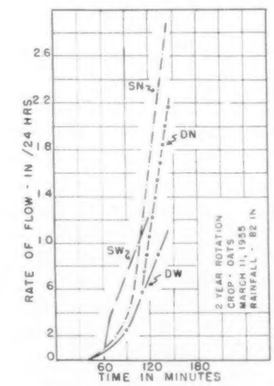

Fig. 5 Effect of tile depth and spacing on rate of increase of tile flow referenced to the time rainfall started

The increasing rates of flow (Figs. 4 and 5) have a linear relationship to time $Q=at+c$. Tile designs SW, DN and DW (Fig. 4) have an exponential form $Q+f(e^t)$ and is assumed to be the result of low-intensity rainfall. The time axis of Fig. 4 is plotted with starting flow being the zero point in order to show the relative rate of increase between tile depth and spacing. Fig. 5 is referenced to the start of the rain. In each case the advantage of shallow depths is evident by the faster rate of increase of tile flow; yet the flow decreases faster and consequently drains less total water from the soil (Fig. 6 and Tables 1 and 2).

The relative importance of tile spacing to degree of drainage is also evident (Figs. 5, 7 and 9), where the area served by the particular tile is reflected in the unit of flow. Variable-intensity rainfalls have not been evaluated nor has the limit of the above relationships been established as affected by rainfall, crop, or soil condition.

The descending curves (Figs. 6 and 7) have a power relationship of $Q=f(t^{-k})$ where time is in hours from the peak flow. The slope of each curve is approximately constant only for sections of the curve and is believed to be a function of the permeability of the soil horizon of the major water source (2, 3)*.

The maximum flow rates in inches per 24 hr are usually in the following order: High SN, DN, SW and DW low,

*Numbers in parentheses refer to the appended references.

TABLE 1. ANNUAL TILE FLOW
Inches Per Acre, 4-year rotation

Tile flow average by crop			
Corn	Small grain	Meadow	Meadow
6.06	6.61	4.74	4.20
Tile flow average by depth and spacing†			
DN	SN	DW	SW
7.52	4.98	5.68	3.43
Tile flow average by years†			
50-51	51-52	52-53	53-54
10.57	8.56	1.03	1.45

Rotation average flow, 5.40

All first order interactions were statistically non-significant.

†Significant at 0.01 level

TABLE 2. ANNUAL TILE FLOW
(Inches per acre)

4-Year Rotation*			
Rotation average, 6.34			
Tile flow average by crop			
Corn	Small grain		
6.06	6.61		
Tile flow average by depth and spacing†			
DN	SN	DW	SW
9.62	5.61	6.44	3.67
Tile flow average by years†			
50-51	51-52	52-53	53-54
11.66	9.74	1.73	2.21
2-Year Rotation*			
Rotation average, 7.88			
Tile flow average by crop			
Corn	Small grain		
7.03	8.72		
Tile flow average by depth and spacing†			
DN	SN	DW	SW
10.81	8.36	7.57	4.76
Tile flow average by years†			
50-51	51-52	52-53	53-54
13.81	12.80	2.20	2.70

All other first order interactions were statistically non-significant.

*Significant at 0.05 level

†Significant at 0.01 level

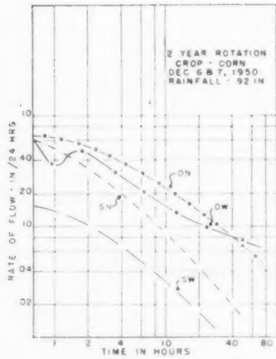

Fig. 6 Effect of tile depth and spacing on rate of decrease of tile flow referenced to maximum flow

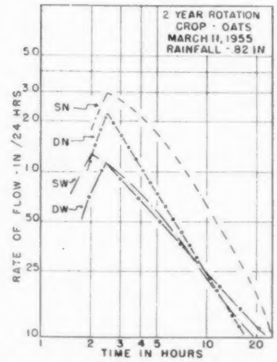

Fig. 7 Effect of tile depth and spacing on rate of decrease of tile flow referenced to the time rainfall started

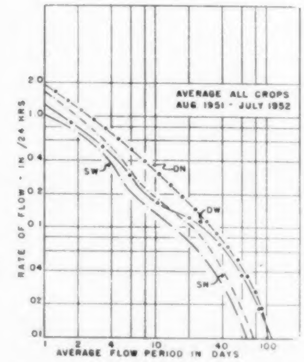

Fig. 8 Average flow-rate-frequency distribution by tile depth and the spacing

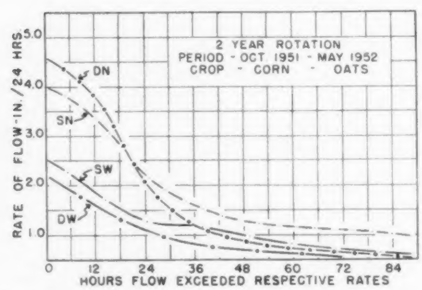

Fig. 9 Excessive flow-rate-frequency distribution by tile depth and spacing

with the spacing variable contributing the major difference. The increase in depths from 2 to 3 ft increases the flow period by approximately 35 percent.

Frequency Distribution

The frequency of various tile-flow rates in inches per 24 hrs is presented in Figs. 8 and 9, both as a 24-hr period and a 1-hr period as the shortest period of evaluation, and shows the number of days the tile flowed at a rate in inches per 24 hr per unit area equal to or greater than the specified value (4).

Rainfall and crops determine the total flow period with a possible interaction between tile design and rainfall distribution.

The interaction between tile design and rainfall is evidenced by the change in relationship of SN and DW from low to high flows. An interaction of crop or rotation with rainfall is not evident at this time. From this and other data any drainage coefficient can be evaluated for efficiency of design. For example, using a ⅜-in drainage coefficient, which is common for tile mains, the capacity has been exceeded approximately 3 percent of the time for the SW design and 6 percent for the DN design regardless of length-of-flow period. The flow period has varied from 33 days (average design minimum, 1952-53) for shallow tile to 200 days (average design maximum, 1950-51) for deep tile over the four years of record. These flow periods are affected by crops with small grains having the longest flow period and meadows the shortest (1).

The days when flow exceeds design capacity are not in sequence but represent the high moisture period of each storm.

Fig. 9 includes all flow in excess of ½ in per 24 hr per acre compiled for 1-hr intervals, for the conditions cited. In all cases for the year 1951-52 the rate of flow, as the zero time limit is approached, is equal to or slightly in excess of the tile lateral carrying capacity in cubic feet per second as normally calculated.

This causes the spacing to be the controlling factor in efficiency of water removal at high flows. Yet total water removed during the wet season is influenced by both depth and spacing.

Flow Accumulated

Annual tile flow in inches per acre is averaged by the various treatments in Tables 1 and 2 and subjected to an analysis of variance. The limitation of replications, mentioned previously, makes it difficult to see the true significance of crop rotation. Most of the difference in tile flow contributed to the various crops (not significant) and rotations (significant at 0.5 percent confidence level) is a function of the evapotranspiration demand of the particular crop or cropping sequence; the designated crop is that preceding the flow period. For example, (Table 1) compare the average tile flow of meadow with grain crops; this difference reflects water demand and difference in rooting system of the particular crop. A comparison of rotations by similar crop (Table 2) reflects the percentage of time the cropping sequence is causing water demands on the soil and not necessarily a difference in soil permeability. Any difference in permeability caused by organic matter input is not evident because other factors are more significant.

The difference in water removed by the various tile depths and spacing was highly significant, with the *DN* tile removing twice that removed by the *SW* tile. The *SN* and *DW* tile are similar, intermediate quantities, but are influenced by years (highly significant interaction) rather than by crops or rotations as expected. The variation in distribution of rainfall and accompanying intensity, from year to year, produce varying relationships of annual tile flow as indicated by the frequency distribution curve (Fig. 8).

The difference in tile flow by years understandably is highly significant, but is of interest because 1950-51 had 40 in of rainfall, 5 in more than normal; 1951-52 was about

(Continued on page 35)

Cooling and Freezing Pan-Ready Turkeys

W. E. Matson, M. C. Ahrens, J. V. Spencer and W. J. Stadelman
Assoc. Member ASAE Assoc. Member ASAE

Bird appearance, tenderness of meat and moisture uptake are influenced, to a significant degree, by cooling methods and freezing storage temperatures. Five cooling methods and three freezing temperatures were studied and analyzed to determine the effects on eviscerated turkeys

THE rapid change to marketing turkeys as pan-ready instead of as dressed birds has brought about many changes. These include increasing scalding temperatures and an increase in the number of turkeys being sold as frozen birds.

The appearance of turkeys is important from the standpoint of consumer acceptability. The effect of freezing (2)* and of scald temperatures (6) as related to appearance of turkeys before freezing had been reported. Baker (1) reported on effects of scalding, cooling and freezing on appearance of chickens.

Lowe (4) comprehensively reviewed previous work relating to palatability of poultry. A later report by Koonz, Darrow and Essary (3) suggests that the processors packaging and freezing directly without cooling may have a problem with tenderness of cooked meat. The practice of cooling dressed and pan-ready chicken meat in ice water results in a moisture uptake by the meat with a resultant greater weight (5, 8).

This study was conducted to determine cooling and freezing characteristics as well as the effect of several cooling treatments on appearance, weight changes, and tenderness of turkeys frozen at three temperatures. The study was a cooperative project between the Washington Farm Electrification Committee and the departments of poultry science and agricultural engineering, State College of Washington, with technical advice and assistance from the Agricultural Research Service, U.S. Department of Agriculture.

Experimental Procedure

Turkey fryers, young hens, young toms and mature hens were processed by subscalding at 140 F, immediately eviscerating, weighing and inserting thermocouples in the breast.

To determine the proper location for the thermocouple, several preliminary trials were conducted. The object was to place the thermocouple in that part of the bird that cools the slowest. In these preliminary tests it was found that the deep breast muscle next to the sternum, the muscle in the center portion of the chest and the deep thigh muscle all required about the same amount of time to cool and freeze to a given temperature. It was decided therefore, that the thermocouple should be placed against the sternum next to the attachment of the fourth rib, because of the ease of locating this position accurately on each bird.

All temperature recordings were accomplished by using two Brown electronic-strip chart-recording potentiometers.

After the thermocouples were in place, the birds were all scored for general appearance. Samples ranged from the best possible appearance down to one which scored unsalable. The birds were then divided at random into four cooling treatments with three birds to each treatment. The cooling methods included *(a)* ice water, *(b)* drained snow ice, *(c)* air at 34 F with birds enclosed in a wet canvas shroud, and *(d)* air at 34 F with birds enclosed in a polyethylene bag. The fifth treatment consisted of no cooling. Instead, warm eviscerated birds were taken directly from the eviscerating line to the freezer. Prior to freezing, each bird was packaged in a polyethylene bag, whether previously cooled or not. The cooling period was from 16 to 20 hr duration. The uncooled birds for the fifth treatment were dressed, eviscerated and scored to coincide with the end of the cooling period for treatments 1, 2, 3, and 4 so that all turkeys were moved to the freezers simultaneously.

The freezing temperatures used were 0 F, —20 F and —40 F. Within each of these freezing compartments, a fan was used to keep the air movement around the turkeys at approximately 500 fpm, to accelerate the rate of freezing (7). As soon as the slowest freezing turkey carcass reached an internal temperature of +5 F in the deep breast muscle, all turkeys were removed from the freezers, unpackaged and scored on the basis of general appearance.

Each turkey was weighed after evisceration, after cooling and after freezing treatments. After the final weighing the frozen birds were sawed in half and one turkey half was placed in 0 F storage for a period of about 10 weeks prior to studying for weight changes on thawing and cooking. Tenderness observations on cooked meat were also made at this time. These weight changes were obtained by weighing the frozen half and then placing it in a polyethylene bag and allowing it to thaw at room temperature, 68 F for 20 hr before weighing again. After the thawed weight was obtained, the leg and breast were removed from the half carcass and weighed individually prior to being wrapped in aluminum foil for roasting in an oven at 300 F. Roasting times were adjusted for the class of turkeys being cooked. Immediately after they were cooked and drained, the parts were weighed again. Tenderness of a section of the breast muscle and of two muscles of the thigh was determined using a sheer force tenderometer. The size of the muscle used was standardized by using two scalpels placed 1 cm apart in a rigid frame and cutting a section 1 cm square for the length of the muscle parallel to the fibers.

The study was replicated three times with fryers, twice with young hens, four times with young toms and three times with mature hens.

In addition to the turkey cooling and freezing studies, several comparative packaging tests were conducted. For

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The authors—W. E. MATSON, M. C. AHRENS, J. V. SPENCER and W. J. STADELMAN—are, respectively, assistant agricultural engineer and associate agricultural engineer, Agricultural Research Service, USDA, and junior poultry scientist and associate poultry scientist, State College of Washington, Pullman.

*Numbers in parentheses refer to the appended references.

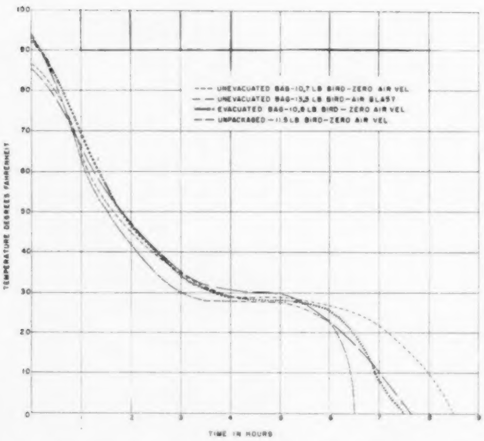

Fig. 1 Freezing rates of eviscerated turkey hens in various types of packages

each test three hot eviscerated birds were used. A thermocouple was placed in the breast of each bird. One bird was placed in an unevacuated polyethylene bag. One was placed in a form-fitting film bag and the bag was evacuated and heat-shrunk to the bird. The third bird was left unpackaged. All three birds were then placed in the —40 F freezer and their temperatures recorded until the carcass temperature reached 0 F. Fig. 1 shows the comparative results of these tests.

Results and Discussions

A comparison of the different cooling rates produced by four cooling methods is shown in Fig. 2. The curves represent cooling rates for turkeys of nearly equal weight. Results indicate that the birds cooled in agitated ice water cooled twice as fast as the second fastest—those in drained ice. Birds in the air blast with the wet canvas shroud were next to the slowest. Those in the polyethylene bags with air blasts were the slowest. In all instances, the turkeys cooled in ice water had a higher appearance score than turkeys cooled by other methods. The turkeys cooled in drained snow ice and those in air with a shroud cover had some discoloration due to dehydration. There was discoloration, but to a lesser degree with those birds air cooled in polyethylene bags. Where the bag was in contact with the skin, a white color resulted. This gave the turkeys a blotched appearance. The appearance scores determined after cooling and freezing, respectively, were subjected to analysis of covariance. In each case, the score of the freshly eviscerated birds was used as the independent variable. Cooling scores were significantly lower, but subsequent freezing masked out many of the differences.

Weight changes during cooling varied from a loss in weight of over 1 percent for the air-cooled, canvas-covered turkeys to a gain of over 5 percent for the ice-water-cooled turkey fryers. The change was significant for all classes of turkeys with the same level of significance being carried through to frozen weights. In Fig. 3 is shown the comparative freezing rates of representative birds frozen in air blasts of 0 F, —20 F and —40 F. The comparison between birds frozen hot and birds cooled in ice water first is also shown. Although there is some difference in the weights of the birds, it may be noticed that had the hot birds been of

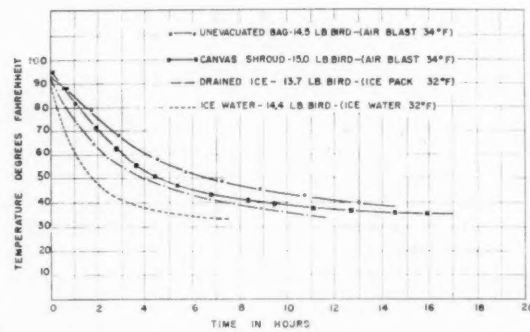

Fig. 2 Cooling rates of the four cooling methods used in the study on eviscerated turkeys

equal weight a greater difference in freezing times would have resulted. From this, we can conclude assuredly that, when comparing freezing times using a —20 F blast, the freezing time will be one-half that using a 0 F blast, and only one-third of the time will be required using a —40 F blast.

In studying the general appearance scores, it was noted that the freezing rate affected the appearance of the birds with relatively little fat covering, especially fryers and young toms. The lower the freezer temperatures, the higher the appearance score of fryers and young toms not previously precooled. There were no statistically significant differences in scoring due to freezing temperatures of either young or mature hens. Slightly greater differences due to freezing rates were found in turkey fryers. These observations agree with previous reports (1, 2).

The hot eviscerated birds required a greater amount of time to reach +5 F than the birds cooled to approximately 40 F prior to freezing. Referring to Fig. 3, it is evident that this is true; however, it required only 10 percent longer for the hot bird to reach +5 F in the 0 F box than it did the precooled bird. In the —20 F box, the difference would be about 25 percent. In the —40 F box, it was approximately 33 percent.

After the frozen birds were thawed, it was readily observable that there was a large moisture loss†. The loss in weight during frying was affected significantly by cooling treatment. Losses for other than ice-water-cooled birds averaged about 2 percent for turkey fryers, 1.5 percent for young toms, and 0.5 percent for young hens and mature hens. The ice-water-cooled birds lost 2 to 4 percent during thawing, with highest losses found in fryers and young toms. Apparently the amount of fat on the carcass affected the moisture loss during thawing. There was a tendency for the birds frozen at 0 F to lose slightly more weight during thawing than those birds frozen at a lower temperature. The effects of cooling treatment and freezing temperatures on weight loss during thawing of young tom turkeys are evident from the data obtained.

The weight loss during cooking was not influenced necessarily by cooling treatment. In all classes of turkeys the weight lost during cooking of ice-water-cooled birds was greater than the loss of turkeys in other cooling treatments. The difference, however, reached significance only for

†Complete statistical data available from the agricultural engineering department, State College of Washington, Pullman.

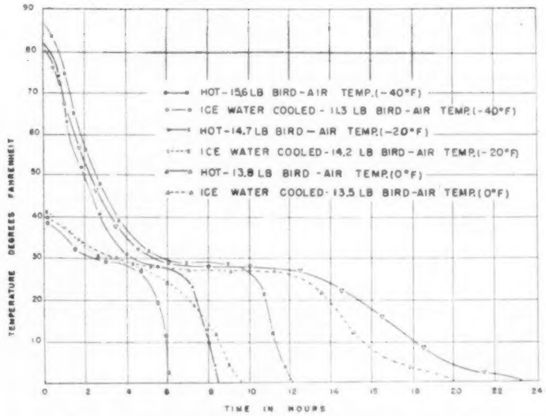

Fig. 3 Freezing rates at three temperatures after various cooling methods

young toms and mature hens. Tenderness of the cooked meat was influenced by the cooling treatment—however, not always significantly. In general the uncooled birds were less tender than the cooled birds. It is quite possible that the difference between treatments was reduced by the thawing period. Unresolved rigor in carcasses not subjected to cooling may have been resolved. The differences were not all significant. They were in agreement with results of Koonz *et al* (3). If the turkeys had been roasted without a thawing period, the magnitude of differences possibly would have reached similar proportions to those reported by Koonz *et al*.

In Fig. 1 are shown some of the results of the packaging tests with eviscerated turkey hens frozen in air at a temperature of —40 F. The importance of evacuating the package so that it will fit around the bird with a minimum of air space can be noted. There was also a difference of over one hour freezing time between the evacuated package and the unevacuated package at a zero air velocity. When the velocity of the air around the unevacuated package was increased to approximately 500 fpm, it still required more than one-half hour longer to freeze than the unevacuated package at zero air velocity.

Conclusions

Four different methods of cooling birds were used. Of the four, the ice-water-cooled birds cooled twice as fast as any other and had the highest appearance score. The 5 percent weight gain of these birds during cooling was also more than for the other methods. The loss during thawing was also greater, being from 2 to 4 percent. The loss during cooking, however, was only slightly more than the other methods, reaching significance only for young toms and mature hens.

The birds were frozen in air blasts of 0 F, —20 F and —40 F. Using a —20 F air blast the freezing time was one-half that using a 0 F blast and only one-third the time was required using a —40 F blast. Freezing rate affected the appearance of the birds with relatively little fat covering, especially fryers and young toms. In these two classes the birds frozen without precooling had better appearance scores as the freezing rate increased. Differences in appearance scores due to freezing rates of young and mature hens were not significant.

Hot birds placed directly in the 0 F freezer required 10 percent longer to reach +5 F than the precooled birds, while in the —20 F freezer the hot birds took 25 percent longer, and in the —40 F freezer they took 33 percent longer.

In general the uncooled birds were less tender than the precooled birds, although not always significantly. Had the birds been roasted without a thawing period, the magnitude of differences possibly would have been greater.

Packaging tests results stressed the importance of the evacuated form fitting container for a faster freezing rate for a given freezing temperature.

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Tile Flow Characteristics

(Continued from page 32)

normal with 34 in. The latter two years were extremely dry with 28 and 25 in, respectively.

Summary

Tile flow response to rainfall is immediate for all practical purposes after the soil moisture is replenished following the growing season. The increasing flow varies directly with time except for low or variable-intensity rainfall.

Tile flow decreases after a storm inversely as some power of time. The exact relationship is influenced by the permeability of the soil horizon being drained.

Maximum rates of flow per unit area are dependent on tile spacing so long as the carrying capacity of the tile is not exceeded. Under the conditions studied the efficiency of design and drainage coefficients are evaluated.

Annual tile flow increases as tile depth increases and as spacing decreases. The relationship of tile flow by depths and spacing is altered by rainfall distribution and intensities.

Drainage requirements differ by rotations and is a function of the demands of the particular cropping sequence.

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Portable Milking Parlor Goes to Cows

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A PORTABLE milking parlor and a plan of dairy-herd management has been proposed as a means of circumventing many objectionable features of the customary routine which necessitates driving the cows to and from the barn twice daily for milking. The plan also includes ways of increasing the efficiency of pasture use through rotation. The proposal is suggested for tropical areas, especially in sections with long periods of high rainfall or having soils with special problems, and in other sections during crop-growing periods.

Many technologists and practical farmers concerned with pastures have received increased nutritional values from their pastures when grazed in a well-managed rotational system. State and federal emphasis on pasture improvement has resulted in widespread investigations of the potential time and grazing capacity of different grasses and legumes. Formal investigations have proven that certain grassland management practices will make available green feed continuously in southern Florida and, at times, permit the harvesting of high-quality forage for making silage or hay. The prescribed pasture management practices involve many important details, out of which efficient, controlled programs of grazing are highly important in the final economic evaluations.

Pasture management practices in England and in the northern European countries have been cited as classic examples of forage productivity as measured *by the yield of milk or meat products.* Frequent references are made to the system of pasture grazing in Holland, where the dairy cows are tethered singly as shown in Fig. 1. The stake, holding a chain attached to a cow's head, is moved ahead each day to allow the cow access to new grass. The Dutch recently have modernized their pasture-management program for dairy cows by transporting a small milking machine to adjacent cows and then move to the next two cows as illustrated in the drawing.

A graphic cow-traffic survey is shown in Fig. 2. For this drawing it was assumed that 100 cows would graze an 80-acre pasture in a rotation system covering 26 days. In actual practice the cows going to and from the barn would be forced to walk in restricted lanes. The broad (black) area leading out of the field indicates the magnitude of cow traffic at that point.

Investigation of a portable milking parlor and a dairy-herd management plan reveals many factors favorable for acceptance in certain areas

Very few grasses can withstand concentrated trampling by cloven hoof animals. Everyone has observed large areas of barren soil about gateways, water troughs, and shaded areas. Heavy rains in hill country produce gullies in barren cow walks. Many soils without vegetative cover and in a water-logged condition have limited load-supporting values. Often cattle sink into the mud and can move about only with great difficulty. The effect of this situation on dairy cows is easily visualized.

Pastures in the Florida Everglades produce excellent yields of forage, but the lands have not attracted dairy farmers largely because barren muck soils will not support a continuous flow of cow traffic. The hard surfacing of an interfarm system of roadways is an expensive undertaking on muck soils. It has been found that spreading marl rock 18 to 24 in deep was not satisfactory for excessive cattle trampling. Acceptable holding pens about a dairy barn are a major engineering undertaking to obtain suitable support for a concrete slab.

The recent general acceptance of large vehicles to transport celery and sweet corn harvesting and packing equipment in the Everglades, has suggested the idea of taking the milking parlor to the cows. This paper is a report on plans developed at the Everglades Experiment Station.

The floor plan shown in Fig. 3, is the typical layout of a recommended lane-type, two-line, six-cow milking parlor within a floor area of 12 x 38 ft. The elevation drawing shows the milking parlor mounted upon a multiple use of wheels equipped with airplane tires. It is believed that such a unit will have ample support on grassland, because the Duda celery harvester-packer unit with a much greater total operating load has ample support on cultivated muckland.

The portable milking parlor as shown contemplates the use of standard equipment, such as a pipe-line milking unit, feed mangers, etc. As an independent unit, it would need a

Paper presented at the annual meeting of the American Society of Agricultural Engineers at Urbana, Ill., June, 1955, as a contribution to Farm Work Efficiency Committee.

The authors — J. W. Randolph, R. W. Kidder and D. W. Beardsley — are, respectively, agricultural engineer, associate animal husbandman, and assistant animal husbandman, Everglades Experiment Station, University of Florida.

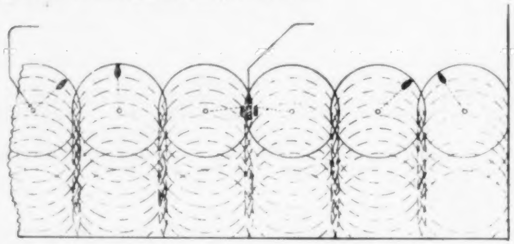


Fig. 1 Pattern of pasture grazing by cows confined by a tether

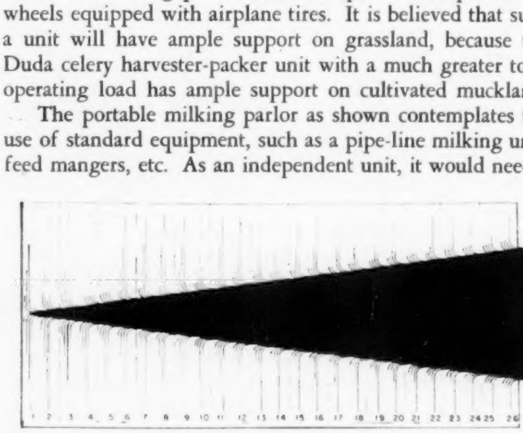
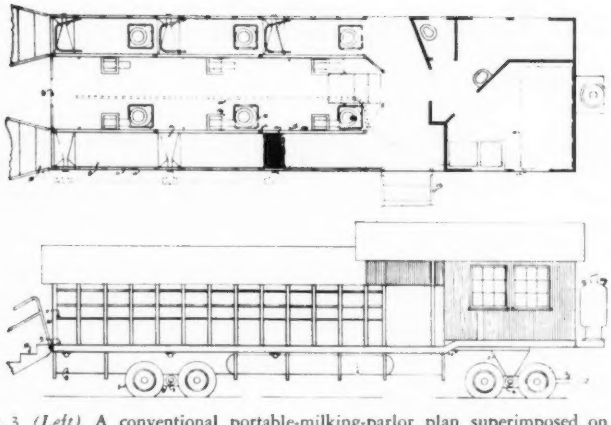


Fig. 2 Graphic representation of dairy-cow traffic concentration. Basis: 100 cows entering and leaving an 80-acre pasture during 26 days, following a twin-rotation system of pasture grazing



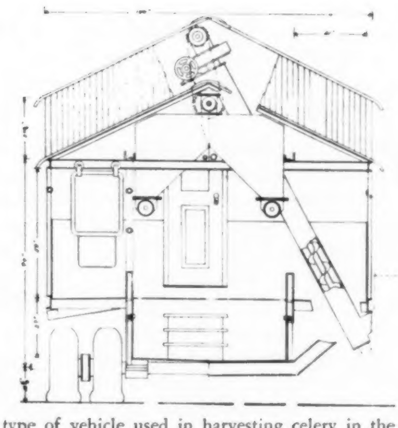


Fig. 3 *(Left)* A conventional portable-milking-parlor plan superimposed on a type of vehicle used in harvesting celery in the Florida Everglades • Fig. 4 *(Right)* Sectional view of a portable milking parlor

motor generator and a pump for obtaining water from shallow wells. Water, as in case of the celery harvester, may be transported from an approved source for washing the milking equipment.

The portable milking unit when used in conjunction with a rotational system of pasture grazing would have waste-water discharge pipes that extend back to previously grazed areas. Such a water disposal would be good for the grasses.

A bulk milk-cooling and holding tank is shown located in the equipment room. Recent studies have indicated that it might be desirable to have the milk cooler mounted in a service truck that could make delivery to the market or to a highway milk transport truck. The needed trucks for hauling milk, feed and laborers might be equipped with special equipment now giving satisfactory service in the Everglades under extreme loose soil conditions. The elimination of interfarm travel by the dairy herd should permit unhampered use of lightweight trucks in the rainy season.

A sectional view of the portable milking parlor is shown in Fig. 4. The left-hand view indicates that the cow will be located over the wheels. The milking pit, resting on the axle, provides a natural low-cost design which uses service members as the structural load-carrying members. The proposed structure will have no cold insulation requirements; hence, it can have a skeleton steel frame and such fill-in solid coverage to meet the service requirements. Canvas drop curtains would be used during rainy days to cover open spaces in the sidewalls.

The right hand part of drawing in Fig. 4, shows auger conveyors for lifting and the distribution of dry feed to six hoppers located conveniently to movable feed mangers. The indicated feed holding features are the only difficult items of construction in the proposal.

Fig. 5 shows a schematic application of the portable milking parlor in a twin system of pasture rotation within areas fenced with an electric fence. The twice daily shifting of the unit means that the concentrated trampling of a given grass area will occur only one time in 26 days based upon the 80-acre plan shown in Fig. 2. The availability of fresh grass after each milking will encourage the cows to enter the milking parlor; therefore, the period of fenced in confinement in the holding pen should be a minimum.

A calculated comparison of the use of the portable milking parlor and like equipment in a conventional building one-half mile from the pasture gate, indicated that under a 26-day rotation grazing program on 80 acres, 100 cows in twice daily trips to the distant milking parlor would walk 1,281 miles in the pasture and 2,600 miles on fenced-in farm roadway. Assuming that a cow's walking speed was 1½ miles per hour, the time loss would be 2,587 cow-hours. The given herd of cows would be handled as a group. Assuming typical rates for milking and other chores, the cows would be away from the pasture 18,200 additional cow hours, giving a total of 33.31 percent pasture feeding time loss.

In further consideration it is believed about one-half the cows would move in and out of the portable milking parlor with only time losses for actual milking chores. The

(Continued on page 41)

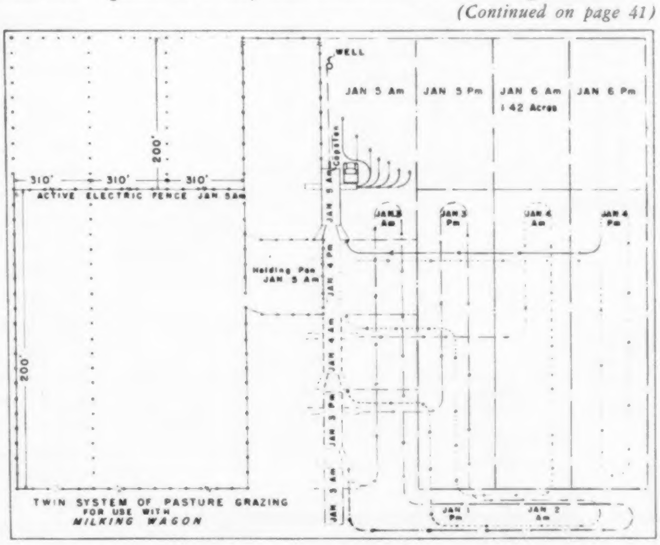


Fig. 5 Schematic application of portable milking parlor in a twin system of pasture rotation within areas enclosed by an electric fence

Planning Pump Drainage Outlets

Curtis L. Larson and Evan R. Allred
Member ASAE Member ASAE

DESPITE the large acreages improved by tile drainage each year, numerous small areas of wet but potentially productive land remain in many sections of the United States. Some of these areas have been left undrained only because they lack a gravity outlet. The use of small, individually owned pumping plants as outlets makes it possible to drain these areas and at reasonable cost. In certain other situations, even though a gravity is obtainable a pumping plant can be used to replace a long tile main or a deep outlet ditch. This may be done either to reduce the cost of the drainage system, or to keep the drainage system within the farm boundaries.

A pump drainage system consists of a collecting system, a pumping plant, and a free outlet. The collecting system may be a series of tile drains, a drainage ditch, or both. The collecting system is designed in the usual manner, except that it discharges into a sump or open pit. The pump lifts the water from the sump to a free outlet, such as a lake, ditch, or natural watercourse. The pumping plant is ususally placed near the free outlet, but in a few cases a saving is possible by locating it somewhere above the natural outlet. Such a location may be advantageous where the power supply is at a considerable distance from the free outlet, or where excessive cuts would be required for the tile main or collecting ditch. One would then use either a shallow ditch or an underground discharge pipe leading to the outlet point.

The pumping plant may be designed for regular service or emergency use. Emergency pumping plants are needed where a gravity outlet is available except for brief periods. Power can be furnished either by electric motors or by internal-combustion engines. The pumping plant may be arranged for automatic, semiautomatic, or manual operation.

The principal parts of a drainage pumping plant are the inlet and discharge pipes, sump, motor, motor controls, and pump. The suggested arrangement of these parts for an automatic pumping plant serving as a tile outlet is shown in Fig. 1. This arrangement has been used for a dozen or more pump drainage systems in Minnesota and Iowa during the past five years, and has proved economical and satisfactory. In the Midwest, a plant of the type shown is applicable to areas of about 30 to 150 acres.

The four main steps in the design of a drainage pumping plant are *(a)* determining suction and discharge levels, *(b)* computing the pumping capacity needed, *(c)* selecting the pump and power unit and *(d)* determining the amount and type of storage required. Each of these steps in the design should be considered from the standpoints of adequacy, permanence, efficiency, and initial cost.

Pumping Lift and Capacity

The pumping lift is an important factor in both the initial and operating cost of a pumping plant. The intake level of the pump depends on the collecting system. For a tile outlet, the water level in the sump should not exceed the invert elevation of the tile main. A higher level would probably reduce the effectiveness of the tile system.

The discharge level of the pump must be chosen according to the physical condition of the natural outlet. Where the tailwater elevation is relatively stable, the discharge pipe can be set just above the maximum water level, thus providing a free discharge at all times. If the tailwater elevation is known to vary considerably, however, operating costs can be reduced by setting the discharge pipe at a somewhat lower elevation. A tight-fitting backwater valve is then needed to prevent back-flow during periods when the discharge pipe is submerged. Although such an arrangement does not reduce the maximum pumping lift, it does reduce the normal operating head.

The pumping capacity required corresponds to the capacity provided for in designing the collecting system. Inasmuch as the pump can operate continuously when necessary, no additional capacity is needed. For converting the capacity of the drainage system to gallons per minute, useful conversions are 1 cfs=448 gpm and 1 inch per day= 18.86 gpm per acre. Because of the quantity of water involved, surface drainage should be disposed of by other means wherever possible. In some cases, all surface drainage can be by-passed through shallow ditches with gravity

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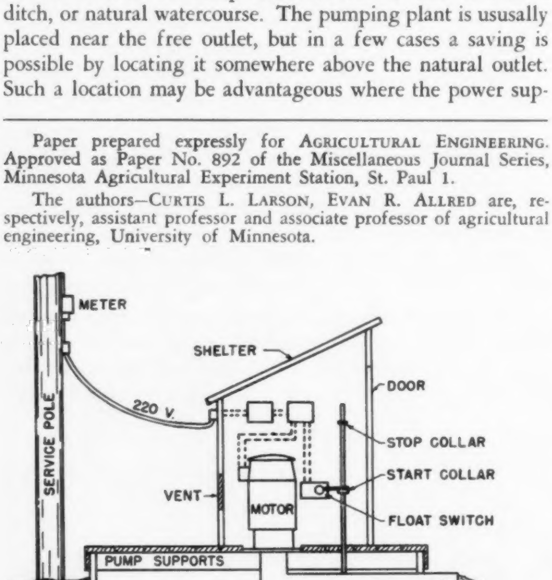


Fig. 1 Arrangement of an automatic drainage pumping plant serving as a tile outlet

outlets, leaving only subsurface drainage to be pumped. Diversion channels can be used in some situations to greatly reduce the amount of surface drainage delivered to the pump.

Pumps and Power Units

Propeller pumps are well suited to pump drainage because of their large capacities at low heads. Also, they are self-priming, low in cost, and easily installed. Inasmuch as propeller pumps are not generally available in sizes less than 6-in diameter, vertical-shaft centrifugal pumps may be used for draining very small areas. Centrifugal pumps of this type are mounted in a submerged position for self-priming. The capacity of the pump depends on its speed and the pumping lift. In selecting a drainage pump, its capacity needs to be adequate only for the minimum-lift condition shown in Fig. 1.

Being adapted to automatic operation, electric drive should be used wherever electric power can be brought to the site at reasonable cost. A direct-connected, vertical-shaft motor is best for trouble-free operation. V-belt drives are used where the pump speed needs to be different from that of the motor. Speeds giving low pump efficiency should be avoided. Stationary engines are usually connected by multiple V belts. The use of a farm tractor is not recommended, except for emergency or auxiliary pumps, since this use is certain to interfere with other uses, and vice versa. Various types of portable pump-engine units may be used for very small areas where electricity is not available. In selecting an electric motor, its horsepower should equal or exceed the horsepower required by the pump for maximum lift (Fig. 1). For most internal-combustion engines, the manufacturer's rating should be approximately twice the horsepower needed by the pump.

With electric drive, automatic operation is obtained by using a float and float switch or a pair of suspended electrodes connected to a relay. Start and stop levels can be adjusted readily on either type. A stilling chamber, as shown in Fig. 1, serves to protect the float from surging or jamming. With engine drive, semiautomatic operation is recommended. The engine is started manually and is stopped by a float switch connected to the ignition system.

Storage Requirements

With an inflow to the sump less than the design amount, a drainage pump must operate intermittently. Sufficient volume of storage must be provided in the sump between start and stop levels to avoid excessive starting and stopping. Storage below the stop level serves only as sediment storage and as clearance for the suction end of the pump.

The quantities involved in a pumping problem of this type are as follows: P=average pumping rate in gpm, I=inflow rate in gpm, s=storage volume in gallons between start and stop levels, and n= number of complete cycles per hour. The length of a complete cycle in minutes is equal to the standing time plus the running time. Writing this statement in terms of the above quantities,

$$\frac{60}{n}=\frac{s}{I}+\frac{s}{P-I}$$

Rearranging and changing from s in gallons to S in cubic feet,

$$Sn=\frac{8I}{P}(P-I) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad [1]$$

This equation can be used to compute the frequency of cycling for given values of S and P, and for various rates of inflow. Note that for $I=P$ or I equals 0, no cycling will take place and no storage is required. However, these are the extreme values rather than the normal conditions.

If equation [1] is differentiated with respect to I, one finds that the maximum S(or n) occurs when $I=\frac{1}{2}P$. For design purposes, the amount of storage required in cubic feet is

$$S=\frac{2P}{N} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad [2]$$

where N is the maximum or permissible number of cycles per hour. The storage depth (D in Fig. 1) and the sump area are chosen so that their product is equal to or greater than S.

At the authors' recommendation, several automatic pumping systems in southern Minnesota have been designed by use of equation [2], using a maximum of 5 cycles per hour. All plants appear to be giving satisfactory service. Two feet was used for the storage depth, D, in most of these installations, although a smaller or larger value is desirable in certain cases. A small value of D requires a rather large sump diameter, while a large value adds to the depth of the sump and increases the pumping lift.

Unless small, the sump should be circular in shape to prevent caving. Concrete silo staves and corrugated metal plate are the materials most frequently used. Sumps up to 20 ft in diameter have been built, but diameters of 12 to 16 ft are most common. Joints in the sump wall need not be sealed nor is a sump bottom required except on sandy subsoils. If the storage required is more than can be provided in an enclosed sump, an open ditch or pit can be constructed for this purpose. If desired, the storage ditch can also serve as a part of the collecting system. The pump may be housed in a small sump connected to the ditch by a culvert, or in a pole structure built in the ditch or pit.

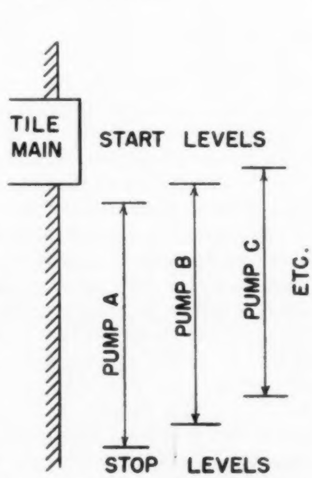


Fig. 2 Float settings for automatic operation with multiple pumps

Multiple Pumps

For acreages too large to be handled by a single pump with a single-phase motor, two or more pumps may be used. Here also the volume of storage is an important factor in the design of the pumping plant. For minimum storage needs, pumps of equal size should be used, and the operating range of each pump should be as shown in Fig. 2. As an example, assume that each of three pumps has a capacity

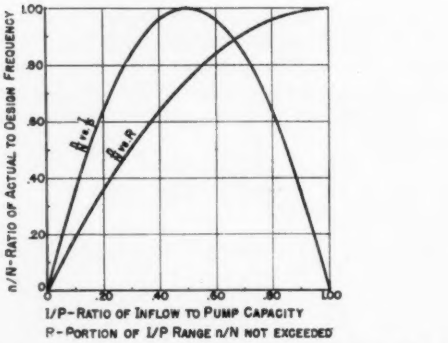


Fig. 3 Relation of frequency of cycling to rates and range of inflow

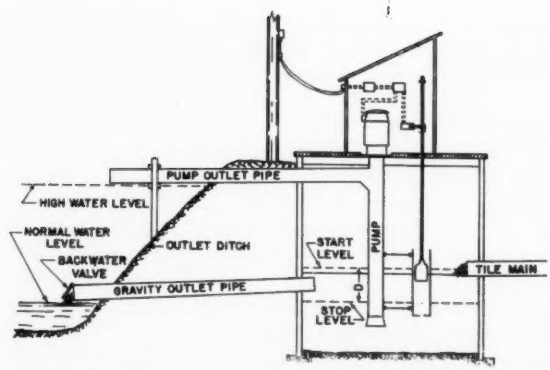


Fig. 4 Arrangement of an automatic emergency pumping plant serving as a tile outlet

of 1000 gpm. The pumps will then operate automatically as follows:

Inflow rate, gpm	Pump A	Type of operation Pump B	Pump C
0 - 1000	Cycling	———	———
1000 - 2000	Continuous	Cycling	———
2000 - 3000	Continuous	Continuous	Cycling

With this arrangement, only one pump is cycling at a time and the storage required is computed by equation [2] using the capacity of one pump only. If the pumps are not of equal capacity, the storage should be based on the largest pump. To equalize operating times of the different pumps, their float settings should be interchanged several times a year.

Semiautomatic Operation

Storage requirements for semiautomatic operation can also be determined by use of equation [2]. However, since starting is manual, the number of cycles should be limited to two per day ($N = 1/12$ cycle per hour). Thus the storage requirement for semiautomatic operation is about 60 times greater than for automatic operation. This is perhaps the major factor in favor of automatic operation. Because of the large amount of storage needed, ditch storage is invariably needed for a semiautomatic or manually operated pumping plant.

A semiautomatic plant should be operated by starting the pump at equal and practical intervals of time, such as 12 or 24 hr. If a pumping plant is designed for two cycles per day, one start per day will be sufficient part of the time and less frequent starts will be needed for very small rates of flow. The question arises as to what portion of the time the less frequent starts will be suitable. In terms of percentage of time, this question can be answered only by considering the relative frequency of differing drainage rates. However, an answer can be given in terms of inflow rates, as indicated by Fig. 3.

In this figure, the relation between frequency of cycling and varying rates of inflow is shown by the curve of n/N vs. I/P. A ratio is used in each case to make the curve generally applicable, regardless of the values used for N and P. The curve shows, for example, that if the design frequency is two cycles per day, one start per day will be adequate when the inflow is less than 15 percent or more than 85 percent of the pump capacity. The same is true for any combination of n and N giving a ratio of 0.50, such as ½ and 1 cycle per day, respectively. The second curve gives the portion of the range of inflow rates, designated R, for which a given value of n/N is adequate. In the above example, one start per day is sufficient for 30 percent of the range, and two starts is needed for the remainder.

These curves show that the number of starts per day used in the design calculations (N) is necessary over a rather wide range of intermediate inflows. It is therefore doubtful that a semiautomatic pumping plant for farm use should ever be designed for more than two starts per day, even though the percentages of time for various frequencies are likely to be somewhat less than indicated by values of R from Fig. 3.

Emergency Plants

An emergency pumping plant is one that is designed for use during periods when the gravity outlet of a drainage system is obstructed. A typical situation requiring an emergency plant is a tile system with an outlet into a large main ditch which flows bank full following heavy rains. If this condition lasts several days, a pumping plant is necessary to prevent damage to or loss of the crops.

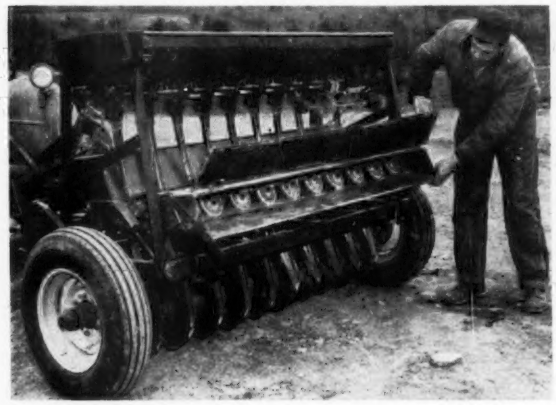
As shown in Fig. 4, an emergency pumping plant may be similar to an ordinary pumping outlet. The main difference is the addition of a culvert which serves as a gravity outlet during low-water conditions in the ditch. Some difference in elevation should be allowed between the tile outlet and the culvert so that the culvert will handle the maximum flow without having the tile outlet submerged. Hydraulic calculations show that, if the culvert is of the same size or larger than the tile main, the head required is very small. Thus the top of the culvert can be set at the same elevation or only slightly higher than the bottom of the tile outlet. This provides adequate head for all rates or inflow.

The remaining parts of an emergency pumping plant may be similar to those of a pumping outlet for regular service. Because of the infrequent operation, efficiency and convenience may be sacrificed to minimize the initial cost. Farm tractors are often used as power units for plants of this type. Where an electric motor is used, automatic controls should be provided. As shown in Fig. 4, the upper float setting should be high enough to permit full flow through the gravity outlet. Storage requirements should be computed by equation [2] as for any other plant, except that a higher frequency of cycling may be permissible both for automatic and semiautomatic systems.

Adapts Drill for Experimental Plots

A MULTIPLE-HOPPER fertilizer-grain drill that can do nearly a day's work in an hour on experimental field plots has been developed at the Cornell University Agricultural Experiment Station.

The new drill, which now has four hoppers with another slated to be added, was developed especially for experimental plot work and is not intended for and would not be practical for farm use. It has three gate openings and can distribute fertilizer and seed in 540 different combinations. It can seed from a low of 1 bu per acre to 8 bu per acre. It is practical for work on research plots where a number of different fertilizers and seeds are used in one field.



Four gear boxes have been added which enable the operator to turn off the flow from any hopper with the flick of a lever. Thus different kinds of fertilizers and seed can be distributed without stopping for cleaning and refilling. By simply releasing a pin, the contents of one hopper can be dumped and cleaned out. The new drill is a modification of a standard drill provided by a commercial firm.

Portable Milking Parlor Goes to Cows

(Continued from page 37)

other one-half of the cows may have a small time loss by being forced into the holding pen. The calculated total time loss based on the above indicated factors will be 3,083 cow-hours, or 4.94 percent of possible hours of grazing.

The actual time increase in effective grazing and the exact labor requirements for the needed chores in management of dairy herd under the proposed system can best be obtained by actual tests. A justification for the proposed experimental unit is contained in a statement by M. U. Mounts, county agricultural agent of Palm Beach county: "Dairying in the Everglades is destined to failure if present systems of production are followed, and some drastic changes in methods must be devised to meet the situation."

In summary the advantages of the proposed portable milking parlor are:

- The distribution of grass trampling so that barren soil areas are avoided.
- At no time will the cattle be forced to wade in mud or be covered with dust.
- It will be possible to follow a systematic pasture rotational grazing program.
- Interfarm roadways will have to be sufficient only for two or three daily movements of a farm truck modified for use in the Everglades.
- No need for extensive hard-surfaced areas devoted to holding-pens.
- Energy and time losses for producing cows traveling to the milking parlor will be kept at a minimum.

Modern Farm Machines Need Modern Greases

FARM implements have been designed perforce to use three basic types of available automotive greases: wheel bearing, chassis or gun, and water pump. This has been done despite the fact that these greases have inherent deficiencies that seem to limit their suitability for the modern farm machine.

From the standpoint of farm machines recently developed, multipurpose greases afford more performance advantages than older types of greases and actually serve a much more useful purpose in farm machines than in passenger cars (see accompanying comparative chart).

In his discussion the author suggests that *(a)* it is not necessarily logical to try to adapt conventional automotive greases to implement needs, *(b)* developments in the field of multipurpose greases are timely in relation to improvements in farm machines, *(c)* continuing work in the area of dispensing and pumpability would seem in order, and *(d)* the need exists for service designations and pumpability ratings for grease which would be of practical value to the builder and to the user.

Summary of a paper by N. A. Sauter, lubrication engineer, materials engineering department, Deere & Company, presented at the annual meeting of the National Lubricating Grease Institute at Chicago, October 31, 1955.

GREASE COMPARATIVE CHART

Characteristic	Wheel bearing	Chassis	Water pump	Multi-purpose
Pumpability when cold	P	G-P	P	G-F*
Suitability for				
(a) 0-160 F (Implements)	F	F-P	F-P	G
(b) Minus 20-160 F (tractors)	F-P	F-P	F-P	G
Suitability at 160 F	G	F-P	F-P	G
Suitability for				
(a) plain bearings	G	G	F	G-F
(b) High-speed anti-friction bearings	G-F	P	P	G-F
Consistency stability	F-P	P	P	G
Fluid friction	F-P	G-F	G	G
Rust protection	G	G-P	F-P	G-P
Overall performance rating				
(1) Average of best values in tabulation above	F plus	F plus	F minus	G
(2) Average of worst values in tabulation above	F minus	P plus	P plus	F plus

*P—poor; F—fair; G—good

NEWS SECTION

ASAE Winter Meeting Sets Record

A NEW Winter Meeting attendance record was set when the American Society of Agricultural Engineers met at Edgewater Beach Hotel, December 11-14. Total registration mounted to 1158, passing last year's count by more than one hundred. Standees were present at many of the technical sessions, while committee meetings and other professional activities were in progress almost continually during the 4-day meeting. Unoccupied meeting rooms were difficult to find, resulting in many unscheduled corridor conferences and more than usual friendly get-togethers to exchange information and ideas.

Throughout the meeting the pressroom was a beehive of activity where news releases and radio-television interviews were coordinated. Ten general news releases on the meeting were sent to UP, INS, AP, City News Bureau and to 22 news directors of radio and television stations. B. F. Cargill, Carl Olson, Frank Lanham and Lloyd Hurlbut made live radio appearances. Merle Esmay and L. W. Bonnicksen appeared on television shows. Tape recordings were made by Don Brown for broadcast over the Michigan State University station and 24 tape recordings were made for broadcasting over radio station WGN in Chicago for several weeks following the meeting. The total broadcasting time amounted to 1½ hours of live time and over 8 hours of tape recordings.

The ASAE Council met Saturday afternoon, most of Sunday and proceeded with little interruption until Tuesday afternoon to dispose of a variety of administrative matters.

The Cabinet meeting held Sunday afternoon was well attended. Wayne H. Worthington, president of ASAE, outlined a proposal for establishing a policy committee to function within the Society to give special attention to consideration of current and proposed policy.

E. T. Swink, chairman of the Virginia Section of ASAE, and J. L. Calhoun, chairman of the local arrangements group for the 1956 ASAE annual meeting, reported on the work being done by the Virginia Section in preparation for the coming annual meeting to be held at Hotel Roanoke, June 17-20.

E. W. Tanquary reported on the progress of the motion picture committee. He explained that the story treatment has been purchased outright by the Society, but that production would not begin until more funds had been received. As a means to increase the motion picture fund, the committee received contributions at the registration desk all during the meeting and presented a green button to each member who made a contribution or had done so in the past.

T. W. Edminster reported on the formation and progress of an intersociety committee on soil compaction. W. M. Carleton presented a progress report on the ASAE military manpower survey. Representatives from various ASAE sections reported on section activity and special projects. The formation of reader groups within the various divisions of the Society for evaluation of technical papers for publication by ASAE was proposed by J. A. Basselman. Action was postponed until a report could be made on the methods used by other societies.

ASAE Meetings Calendar

January 19 — MINNESOTA SECTION, University of Minnesota, Minneapolis.

January 20—QUAD CITY SECTION, East Moline Legion Club, East Moline, Ill.

January 20 — MICHIGAN SECTION, Owosso City Club, Owosso.

February 6-8—SOUTHEAST SECTION, Atlanta, Georgia

February 8 — CONNECTICUT VALLEY SECTION, Publick House, Sturbridge, Mass.

March 2 and 3 — Southwest Section, Grim Hotel, Texarkana, Tex.

June 17-20—49TH ANNUAL MEETING, Hotel Roanoke, Roanoke, Va.

NOTE: Information on the above meetings, including copies of programs, etc., will be sent on request to ASAE, St. Joseph, Mich.

Committee meetings were well attended. Committees on Agricultural Teacher Training, Meetings, and Course Content and the Farm Structures Division Steering Committee met on Sunday. On Monday the following Committees met: Soil Compaction, Terrace Systems, Nomenclature, Public Relations, Research Group, Animal Shelter Ventilation, Farm Fence Construction Standards, Technical Data, Course Content, both the Soil and Water Division and the Power and Machinery Division steering committees, and the Power and Machinery Division's new technical committee.

Ben G. Van Zee was chosen chairman and L. G. Kopp vice-chairman of the Power and Machinery Technical Committee. Several new ASAE standards were studied and recommended to the Council for approval. The formation of a subcommittee was authorized to establish standards for manure spreader capacity ratings.

Committees on Water Storage for Use, Ditch Bank Erosion Control, Farm Safety, Infiltration, Instrumentation and Controls, Crop Drying Equipment, Evaporation-Transpiration, Sprinkler Irrigation Research, Surface Drainage, Farm Work Efficiency, Agricultural Processing, and the Steering Committees on both the Farm Structures and Rural Electric Divisions met on Tuesday.

The Farm Structures Steering Committee met again on Wednesday as did the Committees on Tile Drainage, Motion Picture, and USDA-ASAE Conference Committee on Rural Electrification.

Curt L. Oheim, vice-president of product development, Deere & Company, was the main speaker at the traditional Farm Equipment Institute dinner for agricultural engineers in public service research work. His talk, on the subject of agricultural research and the equipment manufacturer, was the third in a series on research beginning with an address by H. B. Walker two years ago and a follow-up by W. E. Krauss a year ago. Mr. Oheim endorsed increased agricultural engineering research of all classifications, but with a geratly increased emphasis on fundamental research. He stressed the importance of recruitment and training of qualified research workers. He indicated that there is a much better understanding of the value of research than ever before and he felt that the farm equipment industry should give its support, in every way possible, to maintain and increase this research.

The Chicago Section served well in its accustomed capacity as host to the meeting. E. B. Scott, chairman of the Section, was general chairman in charge of local arrangements. Dan A. Kitchen was in charge of public relations; Gerald A. Karstens, in charge of visual aid equipment; Erwin R. Johnson, in charge of registration and information, and Lee H. Ford handled distribution of papers. Mrs. John Wessman and Arnold Daum coordinated the pressroom activities and maintained a steady flow of news releases to the press, radio and television stations.

Midwest Sprinkler Irrigation Conference

The Midwest section of the Sprinkler Irrigation Association and Purdue University are sponsoring jointly the second annual Midwest Sprinkler Irrigation Conference. It will be held on January 16 and 17 at the Purdue University Memorial Union Building, Lafayette, Ind.

The two-day meeting will consist of papers on water rights, water restrictions, agricultural economics outlook, soil moisture measurement, soils management, surface irrigation, ground water geology, and irrigation research. Irrigation equipment dealers, distributors and manufacturers; engineers, county agents, Vo-Ag teachers, bankers and interested persons are invited to attend.

Engineering Education Society Meeting June 25 to 29

The American Society for Engineering Education will hold its Annual Meeting at Iowa State College, Ames, June 25 to 29. Additional information can be obtained from the Office of the Secretary, W. Leighton Collins, University of Illinois, Urbana.

Agricultural Engineering Instruction in New Zealand

THE Society has been informed by G. G. Lindsay, a member of ASAE, presently lecturer in agricultural engineering at Lincoln College, (Canterbury Agricultural College), University of New Zealand, Christchurch, N. Z., that a course in agricultural engineering will start at the college in March, 1956.

The college has been approved as a teaching and examining center for the British national diploma in agricultural engineering (N.D. Agr. E.). The staff of the department consists of a senior lecturer, a lecturer, a technical officer (who is engaged mainly on research projects), two instructors (one in engineering shop work and internal-combustion engines, and one in carpentry), and a technician. In addition, two members of the college farm staff will give some instruction, under the control of the agricultural engineering department, in the field operation of implements and machinery and in farm blacksmithing.

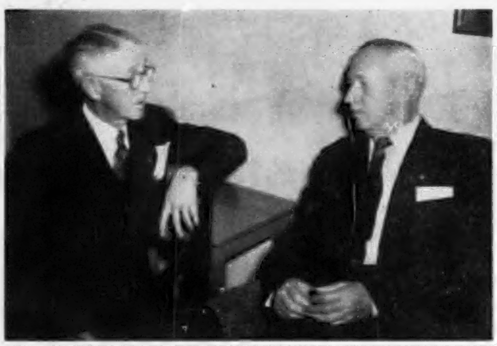
The main building of the department is about 2½ years old and contains, apart from two staff officers, a laboratory measuring 60 by 36 ft, and a machinery instruction room 66 by 36 ft.

The laboratory is supplied with a number of internal-combustion engines, sectioned engines, gearboxes, clutches, water pumps,

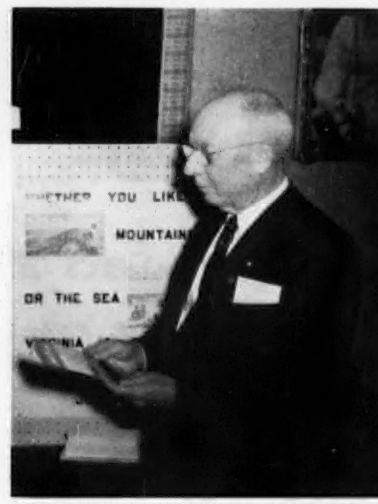
(Continued on page 48)

(Left) Members of the Chicago Section of ASAE, who served as hosts for the Society's Winter Meeting, got together to review the meeting's progress. *(Left to right)* Dan A. Kitchen, in charge of public relations; Erwin R. Johnson, in charge of registration and information; E. B. Scott, general chairman in charge of local arrangements; Gerald A. Karstens, in charge of visual aid equipment, and Lee H. Ford, in charge of distribution of papers • *(Right)* Roy Bainer *(right)* receives a $500 bill to help defray expenses from California to Virginia next June from Vernon H. Baker, chairman of public relations for the 1956 ASAE Annual Meeting. The catch is that the bill is Confederate money

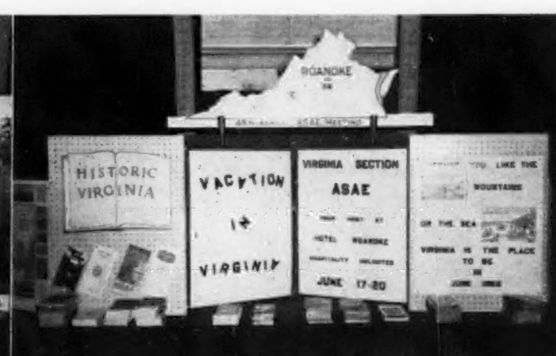
ASAE WINTER MEETING HIGH LIGHTS



Leon A. Hawkins *(left)*, Star Route, Houston, Mo., and Archie A. Stone, special representative, executive offices, International Harvester Co., Washington, D.C., found time to discuss old times and renew memories between technical sessions



Fred A. Wirt, past-president of ASAE and advertising manager, J. I. Case Co., had a gleam in his eye as he looked over some of the travel folders and literature concerning the coming summer meeting in Virginia



The display (shown in two parts) prepared by members of the Virginia Section of ASAE and set up near the registration desk to acquaint members with what is in store for them when they attend the 49th ASAE Annual Meeting to be held in Roanoke, Va., June 17 to 20

J. Dewey Long (past president ASAE) and **Peter C. Coates** have been appointed to the agricultural extension service of Stran-Steel Corp., a unit of National Steel Corp., Ecorse, Detroit, Mich.

In their new assignments they will work cooperatively with agricultural colleges, the U.S. Department of Agriculture, county agents, Agricultural Stabilization Committee officials and various other farm associations to better serve agriculture in work directed toward the development of farm buildings, horticultural crop and grain drying systems, labor saving methods for the farmer, farmstead planning and to effect more efficient methods in the application of farm buildings.

•

Absalom W. Snell has been named head of the agricultural engineering department at Clemson Agricultural College, Clemson, S.C. He was previously associate agricultural engineer and associate professor of agricultural engineering at Clemson.

•

Earle F. Cox has resigned his position with Booz, Allen & Hamilton, of Chicago, to become assistant to the chairman of the board of Motisa Equipment Corp., Washington Heights, Ill.

•

R. C. Giesecke has completed postgraduate work at A. & M. College of Texas and has accepted a position with the McRan Company, Houston, Texas.

•

Kenneth L. McFate, formerly with rural electrification extension, Iowa State College, has accepted a position at the University of Missouri for research in the use of electricity on farms. Work will involve cooperation with power suppliers on tests and utilization of electricity on farms.

ASAE MEMBERS in the News

J. DEWEY LONG

P. C. COATES

Neil A. Dimmick, USDA irrigation engineer, stationed at South Dakota State College, has been transferred to the Newell Irrigation and Dry Land Field Station of USDA at Newell, S. D.

•

William E. Rohaly was recently released from active military service and has returned to his work at the McCormick Works of International Harvester Co. at Chicago, where he will be employed as a design engineer in the advanced engineering department.

•

John D. Cowsar has resigned his position as agricultural engineer with Black, Sivalls & Bryson, Inc., of Kansas City, to accept a position as district manager of American Coin Meter Corp., Colorado Springs, Colo.

Five Elected to Life Membership

THE Council of ASAE during its winter meeting sessions last month in accord with the provisions of Society By-Laws conferred upon the following members the grade of Life Member: B. R. Benjamin, Roy B. Gray, Lewis A. Jones, John C. Wooley and Arnold P. Yerkes.

BERT R. BENJAMIN was born in 1870 in Newton, Iowa. He was graduated in 1893 from Iowa State College with a B.S. degree in mechanical engineering. Until he officially retired, his life's work was with a single company and its successor. Starting as a draftsman-designer of the McCormick Harvesting Machine Co., in 1893, he advanced steadily until his retirement from the International Harvester Co. in 1940. As assistant chief engineer in 1922, he was in charge of the Farmall development for the Harvester Company and earned the title of "daddy of the Farmall tractor" bestowed on him by his associates. Although he was granted 140 patents on farm implements, tractors and tractor attachments, and was responsible for the development and application of the power take-off, his greatest contribution to the tractor industry has been the conception and development of the Farmall tractor. Its basic design has been accepted as the pattern for all-purpose tractors, not only by his own company, but by every experienced and well-established builder of tractors. Its adaptability to row crops and small farms marked a milestone in agriculture and the living standards of the American farmer.

Mr. Benjamin was a recipient of the Cyrus Hall McCormick Medal awarded by the American Society of Agricultural Engineers in 1943.

ROY B. GRAY, recently elected to the grade of Fellow in the Society, has now become a Life Fellow of ASAE. He was born in 1884 in Hampton, Ia., and received B.S. degrees in electrical engineering in 1909 and agricultural engineering in 1910 from Iowa State College. After graduation he was an experimental tractor engineer with International Harvester Co., mostly in foreign countries. In 1921 he was in charge of the department of agricultural engineering at the University of Idaho. He formed an association with the U.S. Department of Agriculture in 1925 when he became head of the division of farm machinery in the Bureau of Plant Industry, Soils, and Agricultural Engineering.

His participation in the planning and establishment of the USDA tillage machinery laboratory at Auburn, Ala., was of particular interest among the many activities he has directed. In 1950 he received the John Deere medal, awarded by the American Society of Agricultural Engineers, and at one time he received the decoration of "Officer du Merite Agricole" from the French government for recognition of services rendered to French agriculture. He served as chairman of ASAE Power and Machinery Division in 1933-34 and of the Washington, D.C., Section in 1941-42.

LEWIS A. JONES was born in 1884 at Pipestone, Minn. He received a B.S. degree in civil engineering from the University of Minnesota in 1907. His first job after college was as assistant drainage engineer and for several months he was assistant city engineer of Mitchell, S. D. Later he spent a few months as allotting surveyor on the Cheyenne Indian Reservation. In 1909 he began work as assistant drainage engineer for the Office of Experiment Stations with the U.S. Department of Agriculture on drainage projects in Idaho, Mississippi and Alabama.

His work in the USDA was interrupted by his service in World War I. He was commissioned a captain and took a company overseas. After the war he was transferred to Washington, D.C. He became the first chief of the Drainage Division of the Bureau of Agricultural Engineering when it was formed in 1931. He continued as chief after the activity was transferred to the Soil Conservation Service in 1939.

An outstanding and creative contribution to agriculture has been his plan for water control in the peat and muck soils of the Florida Everglades. The plan will make possible development of approximately one-half million acres for agricultural use. Other achievements during 40 odd years with the U.S. Department of Agriculture include the planning and supervision of the establishment and operation of 46 Civilian Conservation Corps camps allocated for land-drainage work; the design, operation and cost of pumping for drainage in the Upper Mississippi Valley, and his work with concrete in sulphate waters.

In 1948 the U.S. Department of Agriculture presented Mr. Jones with a Superior Service Award.

JOHN C. WOOLEY was born in 1883 at Crawfordsville, Ia. He received a master of didactics degree in 1912 from Iowa State Teacher's College. After teaching in high school he received a B.S. degree in agricultural engineering in 1917 and an M.S. degree in 1925 from Iowa State College. From 1917 to 1920 he was head of agricultural engineering at University of Idaho. In 1920 he became head of agricultural engineering at the University of Missouri, and served in that capacity until 1948 when he retired.

Mr. Wooley was instrumental in planning the soil conservation experiment station near Bethany, Mo., in 1929, and soon after assumed leadership in the development of the Missouri farm water management system. He has written several text books in the farm buildings field. In 1929 he directed an economic study of farm buildings on over 200 farms in northwest Missouri which has proven to be most valuable and widely used and quoted.

He has served as chairman or member of a number of committees in the Farm Structures, Power and Machinery, Soil and Water, and College divisions of the Society. In 1950 he served as chairman of the Mid-Central Section of ASAE.

Since 1948 he has been a consultant and writer for Johns Manville Co. and in 1950 he became farm buildings consultant to the U.S. Department of Agriculture.

ARNOLD P. YERKES was born on a farm near Davisville, in Bucks County, Pa., in 1885. His formal education was obtained in the local schools, a business college and one year at the Franklin Institute in Philadelphia. He spent three years each in the office of the Inspector of Ordnance, U.S. Army, Midvale Steel Works, and in the Small Arms and Equipment Division. While with the Ordnance Division he devised a correspondence system for writing and filing which has saved much government expense and human attention.

In 1912 he entered the Office of Farm Management, U.S. Department of Agricul-

(Continued on page 48)

With the ASAE Sections

Minnesota Section

A meeting of the Minnesota Section will be held January 19 at 6:15 p.m. in the Coffman Memorial Union on the University of Minnesota campus. Following the dinner, Dean Athelstan Spilhaus, of the Institute of Technology, University of Minnesota, will speak on Air and Sea Resources.

The meeting has been selected as the annual ladies' night. Mrs. Mildred Sampson will be special speaker for the occasion and will talk on Hobbies for Women. She will include a demonstration on enameling metal.

Michigan Section

A meeting of the Michigan section will be held at Owosso City Club, Owosso, on January 20. The program will include talks by E. H. Kidder, Michigan State University, on land and water utilization; Henry N. Luebcke, J. E. Greiner Co., on improved agricultural drainage through better highway design, and Dale Friday, Nitrogen Division, Allied Chemical and Dye Corp., will speak on today's fertilizers. Main speaker will be George D. Scarseth, American Farm Research Association, who will talk on food and fiber.

After luncheon, a tour is planned of the Michigan Vitrified Tile Co. plant at Corunna to observe the manufacture of agricultural draintile.

Quad City Section

The Quad City Section will hold a dinner meeting January 20, 6:00 p.m., at the East Moline Legion Club, 8th Street and 16th Avenue, East Moline, Illinois.

Following the dinner, E. C. Carlson, chief product engineer, International Harvester Co., will present a paper on the subject of Simplified Drafting. Arthur M. Smith, chief agriculturist, Olin Mathieson Chemical Corp., Baltimore, Maryland, will talk on problems of anhydrous ammonia application.

Reservations should be sent to W. L. Stevenson, 2549 Oak St., Bettendorf, Ia.

Connecticut Valley Section

Charles F. Chunglo, Western Massachusetts Electric Co., became the new chairman of the Connecticut Valley Section at a meeting held at the University of Massachusetts, December 8. Other new officers include: John W. Zahradnik, University of Massachusetts, 1st vice-chairman; Richard I. Rich, Eastern States Farmers' Exchange, 2nd vice-chairman; Richard Kinner, Western Massachusetts Electric Co., secretary-treasurer; and the nominating committee consisting of William C. Wheeler, University of Connecticut; Al Barton, University of Massachusetts, and Philip H. Wilson, University of Rhode Island.

A plaque signed by most of the members in recognition of many years of service to the agricultural engineering profession while serving as extension agricultural engineer at University of Massachusetts, Amherst, was presented to W. C. Harrington at the meeting. Carl Harrington is a charter member of the North Atlantic Section and is retiring from his extension duties in the near future.

Harold E. Gulvin previewed his new textbook on mechanized agriculture. James H. Whitaker received a welcome home after two years with Technical Cooperation Mission in India. Julian M. Fore, new head of agricultural engineering, University of Massachusetts, and Philip H. Wilson, new head of mechanized agriculture, University of Rhode Island, were welcomed officially into the section.

The next meeting will be held February 8 at the Publick House in Sturbridge, Mass. Howard Russel of the Massachusetts Mutual Fire Insurance Co. will be the guest speaker.

Southeast Section

A meeting of the Southeast Section will be held in conjunction with the Association of Southern Agricultural Workers, February 6-8, Biltmore Hotel, Atlanta, Ga. Most ASAE sessions will be held in the Educational Building First Baptist Church.

The three-day meeting will hold many concurrent programs representing all divisions of the Society beginning with registration at 8:00 a.m. Monday morning. Sessions begin Monday morning at 9:00 a.m. and continue until Wednesday noon. A general session for all ASAE divisions will be held on Tuesday morning. The theme of the general session is Better Meetings.

A banquet and social hour preceding the banquet are scheduled for Tuesday evening. Wayne H. Worthington, ASAE president, will be the guest speaker at the banquet.

A joint session of several ASAW Sections on Grassland Farming will be held all day Monday.

Copies of the program may be obtained by writing to R. P. Kay, 1332 Marcia Rd., Memphis 17, Tenn.

Southwest Section

The Southwest Section will meet March 2 and 3 at the Grim Hotel, Texarkana, Texas. An interesting and fast-moving session has been promised by the program committee.

ASAE President Wayne H. Worthington will address the group. Other speakers on the program include T. E. Hienton, head, farm electrification section, (AERB, ARS), USDA, Beltsville, Md., who will speak on Around the Corner in Rural Electrification; C. W. Nessell, Mt. Prospect, Ill., who will talk on the Austin Air Conditioned Village —What We've Learned; Price Hobgood, agricultural engineering department, A. & M. College of Texas, whose topic is New Methods for Tilting Concrete Slabs, and M. E. Morris who will describe a new approach to plant irrigation needs. Also planned are panels on Farm Machinery Research in the Southwest and on Irrigation.

Reservations should be mailed directly to the Grim Hotel. Xzin McNeal of Arkansas, C. V. Phagan of Oklahoma and C. E. Ball of Texas served on the program committee.

AE in New Zealand

(Continued from page 42)

a milking machine and cream separators. A hydraulic dynamometer has been installed for measuring engine and belt horsepower. A hydraulic drawbar dynamometer and a tractor field fuel consumption measuring apparatus are also available.

The college is located about 12 miles from Christchurch where a good relationship exists between the college and branches or main dealers of many of the well-known American and British manufacturers of tractors and farm machinery. Within a radius of 100 miles of the college, a considerable amount of research and practical work is being done in soil conservation and irrigation (both by flooding and sprinkling).

The American Society of Agricultural Engineers extends congratulations and best wishes to G. G. Lindsay, to those men associated with him and to Lincoln College for its new curriculum.

(Life Membership)

(Continued from page 46)

ture, as a scientific assistant in agronomy, farm equipment division. By 1915 he was made division head. During World War I he served as assistant to the Farm Equipment Administrator in allocation of materials to the industry. He joined the International Harvester Co. in 1918 where he remained until his retirement in 1950. In 1942 he was appointed as a dollar-a-year man to the Farm Equipment Section of the War Production Board and the following year he was collaborator for the U.S. Department of Agriculture consulting with the Food Production Administration and the War Food Administration. For many years after joining the Harvester staff, he was editor of *Tractor Farming* and *Canadian Tractor Farming*. In 1938 he was made editor-in-chief of the company advertising department and in 1940 he became general supervisor of farm practice research.

Mr. Yerkes was president of ASAE in 1937-38 and was chairman of the Power and Machinery Division in 1925-26. He was awarded the Cyrus Hall McCormick Medal by the Society in 1950.

LETTERS TO THE EDITOR

Report from Colombia

TO THE EDITOR:

We arrived here July 2 and have been kept quite busy. I am representing Michigan State University in the Point Four program here in Colombia. My specific duty is to further the establishment of an acceptable agricultural engineering curriculum, the groundwork for which has been laid by two predecessors.

We are located in the Cauca Valley, a level and fertile area, between two ranges of the Andes. The elevation is about 3000 ft and the climate is wonderful. I seldom wear a hat and am in shirt sleeves much of the time. We sleep under a sheet and quilt most nights. The principal crops here are, in the order of importance (that is, for all of Colombia), coffee, corn, cane, beans and rice. The coffee is grown largely on mountain sides—too steep for any mechanization. Little of it is grown here in this valley.

CHAUNCEY W. SMITH

Facultad de Agronomia
Palmira, Colombia, S. A.

Farm Machinery Development in India

TO THE EDITOR:

My work continues to be divided between development of new animal-drawn implements and the management of the implement factory here at Allahabad Agricultural Institute. In the first year of operation the factory did Rs. (rupee) 106,000 worth of business. That represents quite a large number of implements when most units were valued at less than Rs. 20 each. We are running about the same this year but hope for a bit of increase in the latter part, between now and March 31, 1956.

We have developed a simple riding disk cultivator to work astride the rows, a bullock-powered low-lift pump, a bullock-powered deep-well pump for irrigation and a light 8-disk disk harrow for animal power of new design. The disk harrow and the cultivator have sealed ball bearings. Currently we are working on a simple type of

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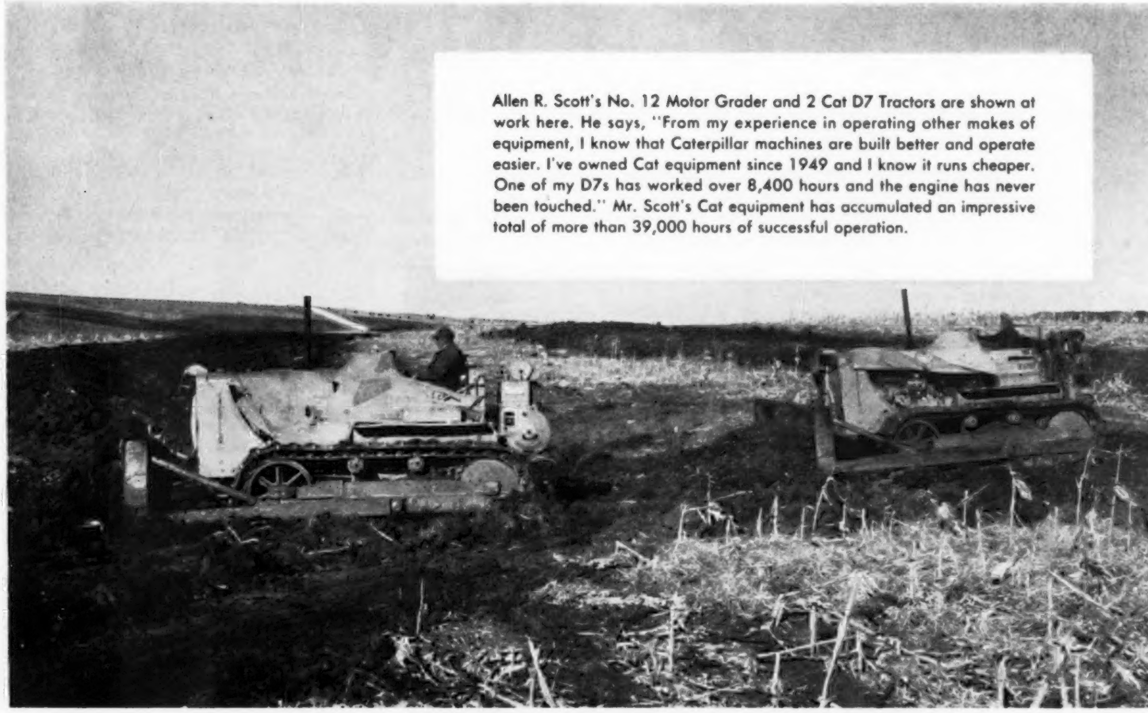


Allen R. Scott's No. 12 Motor Grader and 2 Cat D7 Tractors are shown at work here. He says, "From my experience in operating other makes of equipment, I know that Caterpillar machines are built better and operate easier. I've owned Cat equipment since 1949 and I know it runs cheaper. One of my D7s has worked over 8,400 hours and the engine has never been touched." Mr. Scott's Cat equipment has accumulated an impressive total of more than 39,000 hours of successful operation.

Well-Equipped Contractor

Builds Terraces that Stand Up, Moves Dirt for Less

The key to carrying out a successful land development and soil conservation program often is the farm power contractor equipped with the most efficient tools for the job.

Terraces and ponds built with farmer-owned equipment that may be too small to efficiently move dirt, are a discouraging business for both S.C.S. representative and farmer, and the program is too often discontinued, or the structure done inadequately.

The key is the farm power contractor—for example, the well-equipped spread of Allen Scott, Hickman, Nebraska, is shown here. His CAT* track-type Tractors can do a *complete* land forming and development job: filling in gullies, building waterways, ponds and dams. His Cat Motor Grader is the most efficient machine for building the type of terraces needed here.

Such terraces stand up—they are brought to accurate grade, and the dirt can be moved as far as necessary without creating low spots that are difficult for farm machinery to work through.

Most important, Contractor Scott has dependable Caterpillar equipment that permits him to bid his jobs at lowest cost and still show a profit. He's busy—he keeps his customers satisfied—he makes money.

You, too, can look to the farm power contractor with the yellow machines to be your right-hand man with the know-how that will help establish the watershed districts . . . the soil conservation programs . . . the land development and forming plans your community needs. He's a good man to know!

Caterpillar Tractor Co., Peoria, Ill., U.S.A.

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

NEW PRODUCTS CATALOGS

New Tractor Series

Deere & Co., Moline, Ill., has announced production of the new 420 series tractors—ten models in all—at the Dubuque (Iowa) Tractor Works. The new tractors closely resemble the 40 series, which they replace; but the new 2-cylinder, valve-in-head engine, is said to deliver approximately 20 percent more power. The company estimates that the increase will bring the tractors close to 30 belt hp.

The bore of the aluminum pistons has been increased from 4 to 4¼ in. Other changes have been made in the cylinder head, valve mechanism, manifolding, carburetion

and a compression ratio of 7 to 1. A new pressurized cooling system with water pump and thermostat replaces the thermo-siphon system formerly used. The new engine is available in gasoline and all-fuel types.

A speed-hour meter is available as optional equipment. It indicates engine speed, ground speed, and records hours tractor is operated. The independent disk-type, self-energizing brakes are said to have 25 percent more braking capacity.

Several new working tools have been designed by the company for the new series including 3-bottom pickup plow, and 4-row front-mounted cultivator.

Multipurpose Crop Drier

New Holland Machine Co., New Holland, Pa., has announced production of a

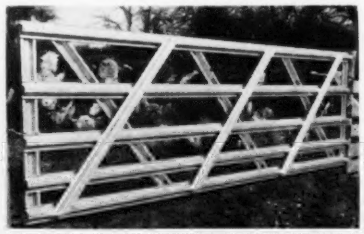
new drier designed for multipurpose crop drying on the average-size farm.

The new drier is portable, and is adaptable to almost any crop drying situation. With multipurpose bins and racks, it will handle everything from hay to grain and ear corn.

The new crop drier is now available in two parts — the model 705 drier and the model 130 drying bin. The crop drier has a 36-in fan powered by a 5-hp electric motor and includes an oil-fired heating unit and thermostatic controls. The all-steel drier bin has a 24-in space between walls and holds 300 bu. Capacity can be increased by adding additional units. The drying bin is in sections and is said to operate equally well with full or partially full bins. Specially engineered augers keep the grain in motion inside the 24-in column. Perforations amounting to 30 percent of the steel bin wall area permit high volume air flow.

All-Aluminum Farm Gate

Aluminum Company of America, 1501 Alcoa Bldg., Pittsburgh 19, Pa., has announced a new all-aluminum farm gate.



Featuring crossed diagonal bracing, it was designed specifically by the company's agricultural engineers. Heavy-duty rolled aluminum sections are riveted together to prevent sagging or twisting. The gate had undergone exhaustive tests to demonstrate its ability to endure heavy usage and weathering. Its light weight makes it easy to handle, even in the 16-ft size. Beaded edges and rounded surfaces prevent scratching or cutting of livestock.

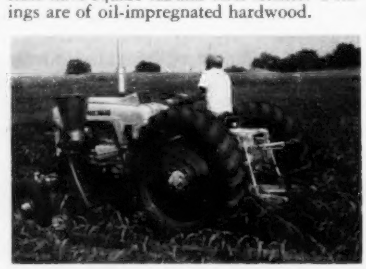
Available in 10, 12, 14 and 16-ft lengths, the gate is 52-in high. The 14-ft model weighs 43 lb. It comes completely assembled, with all accessories including hinges, screw hooks and an aluminum latch chain.

New Line of Implements

Minneapolis-Moline Co., Box 1050, Minneapolis 1, Minn., has unveiled a new line of power-matched implements for the new MM Powerline 445 tractor recently introduced. Finger-tip operation of the hydraulic levers affords instant adjustment of the new 3-point-hitch implements to field conditions.

The new 2 and 3-bottom moldboard and disk plows combine light weight and improved trash clearance with a new tubular steel frame and steel beams. The 1½ x 2¾-in vertical solid steel beams are equipped for attaching plow bottoms or disks to the main frame.

New XO disk harrows in 8 and 9-ft sizes have square tubular steel frames. Bearings are of oil-impregnated hardwood.

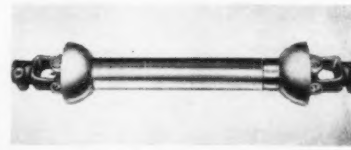


New also are 2 and 4-row cultivators. Frames are of square tubular steel, with round pipe gangs. Another design for 3-point hitch is the reinforced double tool bar carrier, the T-1200. It can utilize two 2, 2¼, or 2½-in tool bars. Two 3-point-hitch A-frames are available with 27 or 32-in centers, using two upper hitch points with 18 or 22-in settings.

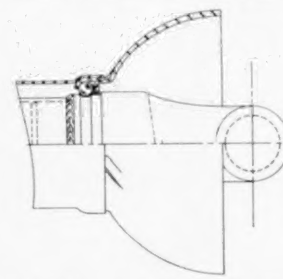
The B1400 middlebreaker with 14, 16 or 22-in bottoms and a new 4-section rotary hoe complete the new line.

Safety Shielded Drive Lines

Blood Brothers Machine Division, Rockwell Spring and Axle Co., Allegan, Mich., has developed a new type, easily removable



integral safety shield for non-slip plain or slip assembly drive lines. The shield rotates on new design bearings. Assembly or disassembly of the shield from the shaft is said



to be quickly and easily done for servicing.

With full ball-bearing construction at each end of shaft, the patented design includes balls in a special cage for servicing. Axial movement allows them to pass over the end of the hub and drop into the machined race for assembly.

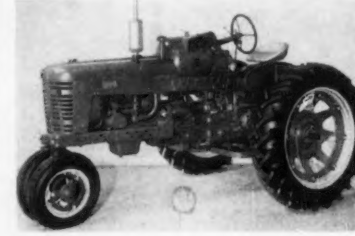
Races are induction-hardened. To keep dust and grit out, bearings are covered by a sealing ring which is held in place by three sheared tongs in the shield bell. To disassemble the unit, tongs are driven outward slightly with a punch and hammer. Bearing assembly is then removed, and the entire joint and shaft assembly slides out of the shield assembly. Tube and shield bell are one unit, and are constructed of heavy wall tubing used on previous designs.

New LP-Gas Tractor

International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill., has announced the McCormick Farmall 300 LP gas 3-plow tractor. The Farmall 300 with gasoline engine was officially tested at 39.84 belt, and 35.87 drawbar hp.

Features include higher compression ratio, 12-volt electrical system, micronic-type fuel filter, special carburetor, regulator-vaporizer unit, and a completely sealed fuel system with special tank and controls. The tractor is fully protected by safety and excess-flow valves.

A new fuel tank also has been announced for the 4-plow Farmall 400 LP gas tractor.



The new tank provides greatly improved operator visibility, for close work with such forward-mounted implements as cultivators.

(Continued on page 52)

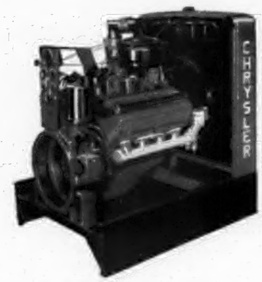
Install Chrysler Industrial Engines

... best-engineered, most-economical answer to your power problem

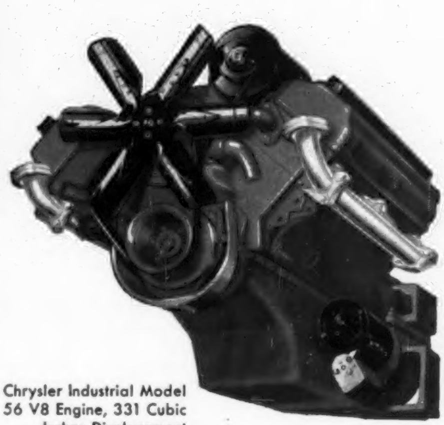
Chrysler Power is the *dependable*, economical, lightweight answer to your high-speed or high-torque power requirements. Within their power ranges, each Chrysler Industrial Engine is a leader in the field and is recognized as such by manufacturers of almost every type of self-powered equipment.

Check the specifications. Note the optional equipment which can be factory supplied or installed to meet the particular requirements of your equipment in the field. Whether equipped for Gasoline, Distillate Fuel, Propane or Natural Gas operation, Chrysler Industrial Engines offer definite advantages . . . performance, ease of maintenance, fast parts service, low initial and operating costs.

See the dealer nearest you, or write for complete information. ***Dept. 116, Industrial Engine Division, Chrysler Corporation, Trenton, Michigan.***



Chrysler Open Power Units. The open power units for all engines include the complete engine, skid base, radiator, instruments and instrument panel, flywheel and flywheel housing. Open power units for V-8 Models Ind. 52 and 56 (pictured), include twenty-five gallon fuel tank.



Chrysler Industrial Model 56 V8 Engine, 331 Cubic Inches Displacement (Front End Chain Drive)

Chrysler Industrial Model 33 Engine, 265 Cubic Inches Displacement (Front End Gear Drive)

Chrysler Enclosed Power Units. The enclosed power units have the complete engine, fuel tank (Models Ind. 30, 31, 32 and 33—sixteen gallon. Models Ind. 52 and 56—twenty-five gallon), storage battery, instruments and instrument panel, flywheel, flywheel housing, skid base and completely enclosing sheet metal.

Optional Equipment—Chrysler Engines

- Chrysler Industrial Torque Converter
- Chrysler gýrol Fluid Coupling
- Three, Four or Five-Speed Transmission
- Twelve or Twenty-four Volt Electrical System
- Distillate, Propane or Natural Gas Burning Carburetor
- Over-Center Clutch and Power Take-Offs
- Vertical or Horizontal Magnetos
- Flexible Coupling for Truck-Type Flywheel
- Radio Shielding and Ignitors
- Heavy-Duty Oil Bath Air Cleaners
- Safety Switches (Low Oil Pressure, High Water Temperature)
- Corrosion or Fungus Resistant Electrical System

GENERAL SPECIFICATIONS ALL MODELS

	Ind. 30	Ind. 31	Ind. 32	Ind. 33	Ind. 52	Ind. 56
No. of Cylinders	6	6	6	6	8	8
Type of Engine—4 Cycle	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Bore—Inches	3¼	3¼	3 7/16	3 7/16	3 7/16	3 13/16
Stroke—Inches	4⅝	4⅝	4¾	4¾	3¼	3⅝
Displacement—Cu. In.	230	230	265	265	270	331
Compression Ratio	7.0	7.0	6.8	6.8	7.5	7.5
Valves—Arrangement	L	L	L	L	Vee	Vee
Pistons—No. Rings	4	4	4	4	3	3
Crankshaft—Bearings	4	4	4	4	5	5
Camshaft Drive	Silent Chain	Gear	Silent Chain	Gear	Silent Chain	Silent Chain
Camshaft—Bearings	4	4	4	4	5	5
Crankshaft—Bearing Diameter	2½"	2½"	2½"	2½"	2⅜"	2½"
Lubrication—Type	Press.	Press.	Press.	Press.	Press.	Press.
Lubrication—Type Oil Pump	Rotor	Rotor	Rotor	Rotor	Rotor	Rotor
Lubrication—Oil Capacity Qts.	5	5	5	5	5	5
Ignition—Battery Type	Yes	Yes	Yes	Yes	Yes	Yes
Spark Plug—Size	14 mm	14 mm	14 mm	14 mm	14 mm	14 mm
Starting—Elec. Type	6 Volt	6 Volt	6 Volt	6 Volt	6 Volt	6 Volt
Gen. Reg.—Full Voltage	45 Amps.	45 Amps.	45 Amps.	45 Amps.	45 Amps.	45 Amps.
Gen. Reg.—Full Voltage and Current Control	Yes	Yes	Yes	Yes	Yes	Yes
Carburetor—Type	Down-Draft	Down-Draft	Down-Draft	Down-Draft	Down-Draft	Down-Draft
Fuel Pump	Yes	Yes	Yes	Yes	Yes	Yes
Weight—Approx. (Lbs.)	575	610	740	760	591	845

Specifications subject to change without notice.

HORSEPOWER WITH A PEDIGREE

CHRYSLER INDUSTRIAL ENGINES

INDUSTRIAL ENGINE DIVISION • CHRYSLER CORPORATION

New Products and Catalogs

(Continued from page 50)

Sprinkler Water Timer

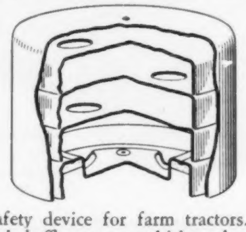
Kaye and Miller Machine Co., 9456 W. Jefferson Ave., Culver City, Calif., has announced a new product, the K-M-T water timer. The timer automatically shuts off

water in periods from 1 min to 1 hr and is designed for heavy-duty use in sprinkler systems.

The valve is constructed of non-corrosive solid brass and contains a vacuum breaker. Pipe threads of ¾ in are used.

Safety Gas Cap

International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill., has developed a

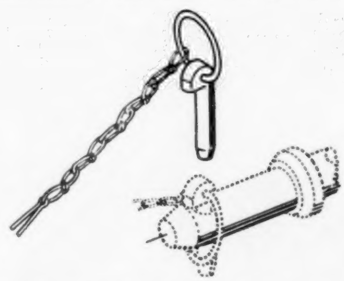


new safety device for farm tractors. It is the triple-baffle gas cap which replaces conventional caps and prevents squirting or splashing of gasoline from the tractor tank. It also prevents dirt or dust from entering.

The new device is said to minimize fire hazards in field, shed, or barn. It is designed to fit all gasoline tanks on tractors manufactured by the company since 1938.

New Pin Fasteners

Danuser Machine Co., 500 E. Third St., Fulton, Mo., has developed a new type fastener, called the Klik-Pin, used to replace the cotter pin. It substitutes a steel pin for the conventional split cotter. This pin is re-



tained in place by a tempered steel snap ring which clicks over the end of the shaft in which the pin is inserted. The company uses these pins to attach 3-point-hitch implements to various make farm tractors.

The snap rings are wound so that the direction of spiral keeps them firmly closed. Holes for the ends of the rings are drilled only partially through the pin, allowing the ends of the ring to bottom in the hole. This provides a pivotal bearing and increases snap of the ring. Pins are forged from high-carbon steel and then heat treated. They are being manufactured in 7/16 and 1/4-in sizes with two snap ring sizes and optional retaining chains.

New 3-Point Hitch

Deere & Company, Moline, Ill., has introduced its new Traction-Trol 3-point hitch for the company's 50, 60, and 70 tractors.

The company also announces a new 4-bottom fully integral moldboard plow, first in a series of new equipment for use with the new hitch.

The No. 801 hitch reportedly transfers weight from the plow (or other tillage implement) and the front of the tractor, to the tractor drive wheels. Also, it is said to transform some of the plow's draft resistance into downward pressure on the tractor rear axle. Added traction thus obtained is proportionate to the draft resistance of the plow. The new hitch does not change depth of plowing. The company claims that traction is gained without side draft and without adversely affecting tractor front-end stability or steering.

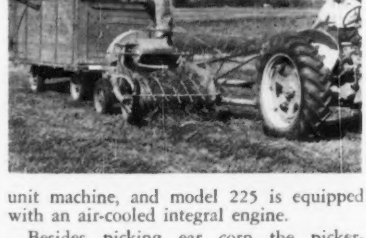
All implements made for use with the previous Nos. 800 and 800A hitches fit the new No. 801 without modification; the two previous hitches can be converted at low cost.

The new 4-bottom integral plow No. 814 has truss-frame design, trip standards, and is available with high-speed bottoms, coulters, and the new cover disks, which replace jointers.

Multiple Unit Forage Harvester

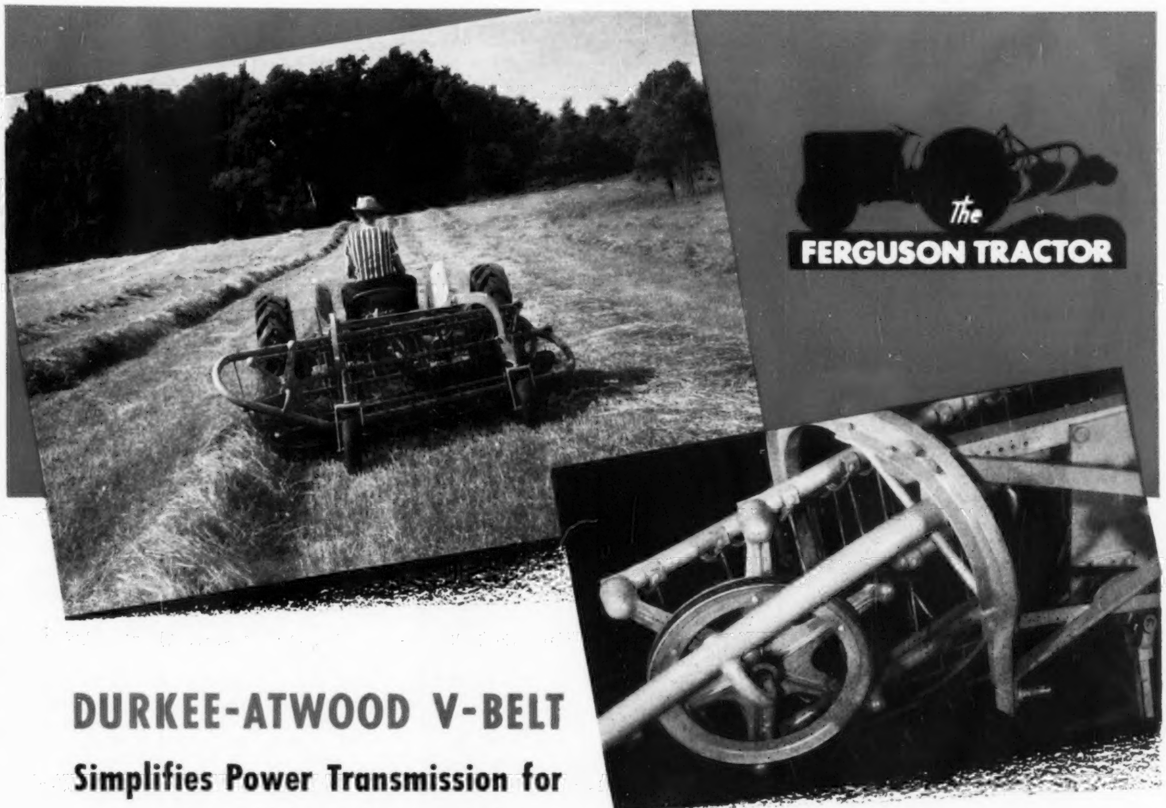
J. I. Case Co., Racine, Wis., has announced production of a new Model 200 multiple unit forage harvester. A choice of three different base units is available for use with any of four crop heads. Base units vary according to number of knives, PTO, or engine drive. Crop heads include a 60-in cutterbar head, row-crop head, windrow pickup head, and corn picker-chopper head.

Model 210 uses a 4-knife flywheel for standard cutting of grass silage, corn, or sorghum silage. Model 220 is a 6-knife base



unit machine, and model 225 is equipped with an air-cooled integral engine.

Besides picking ear corn the picker-chopper head chops the stalks and leaves. The chopped material can be used for feed, livestock-bedding, or blown on the ground. Provision is made for saving loose or shelled corn. Mechanical or hydraulic controls are within easy reach of the operator from the tractor seat.



DURKEE-ATWOOD V-BELT

Simplifies Power Transmission for Ferguson Side-Delivery Rake

The Ferguson Side-Delivery Rake is unit-mounted on the tractor and driven from the power take-off by a single Durkee-Atwood V-Belt. This drives the right-hand reel spider with no cams, gears or chains to wear out or cause trouble, and eliminates the ground drive with its usual slippage and complicated moving, driving and wearing mechanisms.

The six-bar reel and special offset placement of bars permits raking at speeds up to 10 miles per hour. Should the reel become jammed accidentally, the V-belt drive allows sufficient slippage for protection.

D-A ENGINEERING Integrates the V-Belt with the Application

Durkee-Atwood engineers collaborated with Ferguson engineers in overcoming design problems of the V-belt drive for the Ferguson Side-Delivery Rake. The result was a specially constructed V-belt that does an outstanding job.

If you have a V-belt problem, Durkee-Atwood's facilities are at your command. Ask Durkee-Atwood—your best source for engineering assistance and highest quality V-belts for agricultural equipment.

Form No. 545

DA PRODUCTS SINCE 1910

DURKEE ATWOOD V-BELTS

DURKEE-ATWOOD COMPANY

Dept. AG-1 MINNEAPOLIS 13, MINNESOTA

Suppliers of original equipment V-Belts for major manufacturers of:

COMBINES • MOWERS • HAY RAKES • FORAGE HARVESTERS
CORN PICKERS • WINDROWERS • CHOPPERS • COTTON PICKERS

NEW BULLETINS

Engineering Standards Multiple V-Belt Drives (revised) by Multiple V-Belt Drive and Mechanical Power Transmission Assn, 27 E. Monroe St., Chicago 3, Ill., and The Rubber Manufacturers Assn, 444 Madison Ave., New York 22, N. Y. The data in the manual is based on the latest engineering opinion and research, and indicates the proper sheaves and belts to be used for the attainment of optimum efficiency and economy of the drive with relation to the particular duty to be performed.

Basic changes in the revised manual include 10 pages of new horsepower ratings. For the first time ratings on premium quality belts are included. Ratings for belt speeds from 200 to 6,000 fpm are shown. The basic formulas used in obtaining the new ratings are shown. Manufacturing tolerances have been shown for sheave groove profile dimensions for standard and deep groove sheaves. Matching limits have been revised.

Progress Report on Peanut Harvesting by Buford M. Cannon. North Carolina Agricultural Experiment Station (Raleigh) Information Circular No. 10 (August 1955). This report presents the progress of work being done by the experiment station in an attempt to develop and evaluate new harvesting methods aimed at a more efficient and economical operation combined with an improved quality of the product.

Improving and Constructing Mailbox Stands in Georgia, by G. C. Barnhill, Hugh Roberts, R. R. Harris and W. E. Hudson. Vocational Education in Agriculture, vol. XXXVI, no. 7 (June, 1955), Department of Agricultural Education, University of Georgia, Athens. The 24-page bulletin contains detailed plans and procedure for constructing five types of mailbox stands. It should be helpful in teaching boys and farmers to make a decision on the type of stand to construct and for developing necessary skills in construction.

NEW BOOKS

Crop Protection, by G. J. Rose. Cloth, xxi + 223 pages, 5½ x 8½ inches. Illustrated and indexed. Philosophical Library, Inc., 15 East 40th St., New York 16, N. Y. $10.00.

This book is written for the cultivator—whether large or small—faced with the problem of protecting his crops. The first section is devoted to general considerations, cultural control, dusts, baits, smokes, fumigants, solutions, emulsions and suspensions. The second section deals with chemicals; the third section covers application machinery, and the final section deals with the protection of stored products.

Directory of Wheel and Track-Type Tractors Produced Throughout the World, by Food and Agriculture Organization of the United Nations, Viale delle Terme di Caracalla, Rome, Italy. Cloth, 371 pages, 8½ x 13 inches. $3.00.

The directory includes specifications of tractors obtained from the manufacturers or from official publications. It is written in English, French and Spanish with specifications given both in the metric and English systems. The book is divided into three parts. The first part gives the addresses of manufacturers. The second part lists the specifications of wheel-type tractors and the third part is devoted to track-type tractors. Specifications range from dimensions to engine specifications and output ratings.

Hydraulic and Pneumatic Operation of Machines, by H. C. Town. Cloth. 192 pages, 6 x 9 inches. Illustrated and indexed. Philosophical Library, Inc., 15 East 40th St., New York 16, N. Y. $7.50.

The book is divided into two parts. The first part deals with the advantages and limitations of oil for power transmission and shows the main types of pumps used. The second part deals with pneumatic developments and includes chapters on air compressors and structural details; the operation and maintenance of pneumatic tools, and the design of pneumatic circuits. Also described are hydro-pneumatic devices and air-hydraulic feed units.

Electro-Magnetic Machines, by R. Langlois-Berthelot. Cloth, xvi + 519 pages, 5½ x 8½ inches. Illustrated and indexed. Philosophical Library, Inc., 15 East 40th St., New York 16, N. Y. $15.00.

The book was first published in France. The English edition was published to provide more opportunity for students, lecturers, technicians, and industrialists to profit from the author's experience and unique method of presentation. The book is divided into six parts. Part one describes the various families of machines, reviewing their properties and applications. The second part covers the general constitution and stenography of machines. The machine from the designer's standpoint is reviewed in the third part; while the machine from the user's standpoint is covered in part four. In the fifth part abnormal conditions of operation are dealt with. Part six discusses generally various ideas such as flux, reactive power and industrial research.

PERSONAL SERVICE BULLETIN

NOTE: In this bulletin the following listings current and previously reported are not repeated in detail; for further information see the issue of AGRICULTURAL ENGINEERING indicated.

POSITIONS OPEN—JUNE—O-248-733. JULY—O-307-739, 316-740. AUGUST—O-305-741, 325-743, 324-745, 334-746, 338-747, 345-748, 346-749, 346-750, 347-751, 350-752. SEPTEMBER—O-331-754, 363-755, 335-756, 352-758, 372-759, 384-760. OCTOBER—O-402-762, 402-763, 404-764, 405-765, 409-766, 409-767, 409-768, 407-769, 407-770, 407-771, 413-772, 415-773, 394-774. NOVEMBER—O-385-775, 430-776, 439-777, 451-779, 453-780, 453-781, 454-782, 448-783, 463-784, 463-785. DECEMBER—O-401-761, 476-786, 503-787, 504-788.

POSITIONS WANTED—JUNE—W-203-25, 252-29, 263-31. AUGUST—W-312-40. SEPTEMBER—W-351-41. OCTOBER—W-383-43, 398-45, 375-47, 420-48. NOVEMBER—W-412-49, 428-50, 429-51, 445-52, 450-53. DECEMBER—W-458-56, 486-57, 489-58, 480-59.

NEW POSITIONS OPEN

AGRICULTURAL ENGINEER for product design and layout on farm implements, mostly tillage equipment, in California plant of a major farm equipment manufacturer. Age 22-30. BS deg in agricultural engineering. Farm background and experience in the use of farm machinery and tractors. Genuine interest in farm equipment design, and ability to work and cooperate with others. Opportunity to grow with company as its line of equipment is broadened. Salary open. W-55-789

SALES REPRESENTATIVES wanted to sell full line of steel farm buildings. Excellent market, growing business. Attractive financing plan for farmer. Farm background and some sales experience required. Salary, expenses and bonus. Excellent opportunity to advance into sales management. Write age, education, experience, family, telephone number to O-534-790

ENGINEER to manage irrigation equipment company wanted. An outstanding opportunity for an engineer, between the ages of 35-40, with experience in the sale and technical phases of portable sprinkler irrigation. The man selected will have complete charge of an irrigation distributing company. He should be a graduate engineer, have the ability to develop and train a dealer organization, and be able to supply technical assistance to dealers. Salary and commission. Interested persons who meet these qualifications and are willing to relocate, write O-537-791. All replies strictly confidential.

NEW POSITIONS WANTED

AGRICULTURAL ENGINEER for design, development, research, sales or service in power and machinery or soil and water field with manufacturer, processor, or distributor in West Central USA. Married. Age 29. No disability. BS deg in agricultural engineering, 1952, A & M College of New Mexico. Farm background, including experience with farm machinery. Rural electrification 2½ yr, including horsepower checks and efficiency tests on irrigation wells. Meter shop work 2½ yr. War enlisted experience in Air Force, 3 yr, including welding, radio, and electronics. Hold private pilot license. Available on 2 to 4 weeks notice. Salary open. W-457-60

AGRICULTURAL ENGINEER for design, development or research work in agricultural machinery or soil and water conservation with industry or public service for 2-3-year period anywhere in USA or Canada. Age 25. Nationality, Indian. Single. No disability, will travel, BS deg in agricultural engineering, 1950, Allahabad University. Three years field experience in soil and water. PhD degree in agricultural engineering expected from Durham University, England, by January 1956. Available March 1956. Salary open. W-528-61

AGRICULTURAL ENGINEER, ultimate goal, administrative engineer on management team in progressive private or public organization dedicated to the application of modern engineering methods to agriculture. Immediate goal, engineering administrative assistant, field test engineer, or design engineer. Currently in farm machine design. Will consider other fields of agricultural engineering. BS deg in agricultural engineering, University of California. Farm machine design 5 years. Subprofessional engineering 5 years. Farm background. Technical writing and teaching experience. Minor in business administration. Wartime Army officer with both field and administrative duties. Married. Age 37. No disability. Available on 30-day notice. Salary open. W-529-62

Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Beer, Craig E.—Instructor in agricultural engineering, Iowa State College, Ames, Iowa

Blackburn, Keith B. — Work unit engineer (SCS), USDA. (Mail) PO Box 613, Rexburg, Ida.

Brown, H. C.—Research assistant, University of Tennessee, Knoxville, Tenn. (Mail) 131 Quincy Ave., N.E.

Carter, Lyle M.—Agent, agricultural engineer (AERB, ARS), USDA. (Mail) Agricultural Engineering Dept., Texas A. and M. College, College Station, Tex.

Castillo, Eduardo A. — Agricultural engineer, 4a, Avenida 11-50, Zona 1, Guatemala, Guatemala.

Collins, Richard V.—Product research engineer, Butler Mfg. Co. (Mail) 6707 W. 77th St., Overland Park, Kans.

Cook, Henry C.—Hydraulic engineer, Bureau of Reclamation (USDI). (Mail) PO Box 103, Centreville, Ala.

Crosno, J. M. — Power-use adviser, Corn Belt Electric Cooperative, Inc., P.O. Box 816, Bloomington, Ill.

Ertel, Edward E. — On duty with armed forces. (Mail) 203 E. Walnut, Shelbina, Montana

Fasken, Guy B.—Drainage engineer (SCS), USDA. (Mail) 434 N. Plankinton Ave., Milwaukee 3, Wis.

George, Theodore J.—Teaching assistant in civil engineering, University of California. (Mail) 2829 Benvenue, Berkeley 5, Calif.

Gordon, Jr., Walter B. — On duty with USAF. (Mail) Box 746, Bainbridge Air Base, Ga.

Griffin, James A. — Electrical development representative TVA. (Mail) RR 1, Thorsby, Ala.

Guess, Jr., St. Clair P. — Executive secretary, South Carolina Soil Conservation Committee, Columbia, S. C. (Mail) 5140 Furman Ave.

Halsey, David C.—Senior engineer, Vickers, Inc., Div. of Sperry Rand Corp., 1400 Oakman Blvd., Detroit 32, Mich.

Hartshorn Jr., Floyd J.—District manager, Timken Roller Bearing Co. (Mail) 4444 W. Capitol Dr., Milwaukee 16, Wis.

Hellenberg, Clare E.—Assistant chief engineer, Vickers, Inc., Div. of Sperry Rand Corp. (Mail) 5740 Bloomfield Glens, Birmingham, Mich.

Higginbotham, Jack D.—Production trainee, Ralston Purina Co., 3815 Hiawatha Ave., Minneapolis, Minn.

Hutto, Jr., Azel J. — On duty with U.S.A. (Mail) 420 Carolina Ave., Orangeburg, South Carolina

Jaeger, Mordechai — Design engineer, American Machinery Corp. (Mail) 1250 S. Pennsylvania Ave., Winter Park, Fla.

Jones, Wilton A.—Assistant extension agricultural engineer, Clemson Agricultural College, Clemson, S. C. (Mail) Box 482

Kehrer, James R. — Self-employed, Montoursville, Pa.

Kenedy, Lowell — Agricultural engineer (SCS), USDA. (Mail) RR 2, Colfax, Wash.

King, Richard L. — Agricultural engineer (SCS), USDA. (Mail) 711 Jefferson, Iowa City, Iowa

Land, Richard E. — Agricultural engineer (SCS), USDA. (Mail) RR 7, Lafayette, Indiana

Lane L. Job. — Rua Baroneza de Itu 830, Sao Paulo, Brazil, S. A. (Mail) Caixa Postal 2887

Lewis, David G. — Engineer trainee, John Deere Waterloo Tractor Works, Waterloo, Iowa. (Mail) 320 Vine St.

McKenzie, Martin C.—Extension agricultural engineer, Clemson Agricultural College, Clemson, S. C. (Mail) PO Box 128

Marques, Manuel D. — Student in agricultural engineering, California State Polytechnic College, Box 1597, San Luis Obispo, Calif.

Mattu, R. K.—Mechanical supervisor, Central Tractor Organization, India Ministry of Food, New Delhi, India. (Mail) 2 Electric Lane

Michael, Arayathinal M.—Lecturer in agricultural engineering, S.K.N. Agricultural Institute, Jobner, Jaipur, India.

Moore, William G.—Project engineer, Lilliston Implement Co., Gillionville Rd., Albany, Ga.

(Continued on page 60)

Applicants for Membership

(Continued from page 58)

Morse, Arnold S. — Agricultural engineer, Portland Cement Assn., 50 W. Broad St., Columbus 15, Ohio

Murray, James M. — Drainage engineer, drainage div., PFRA, Vauxhall, Alta, Canada. (Mail) Box 166

Neal, Maurice E. B.—Agricultural engineer, FAO Technical Assistance Mission, Katugastota, Ceylon

O'Neill, Jr., Edward R.—Manager, implement product planning dept., Tractor & Implement Div., Ford Motor Co., Birmingham, Mich. (Mail) 17934 Birwood Avenue

Palermo, Frank J.—Works manager, J. I. Case Co. (Mail) 1100 Montvue Rd., Anniston, Ala.

Paulk, Jacob W. — On duty with USAF. (Mail) Det. 826 Wea. Sq., APO 845, New York, N. Y.

Perrin, David P.—Engineering trainee, General Electric Co. (Mail) RFD 3, Barre, Vermont

Piper, Loren E. — On duty with USAF. (Mail) 227 N. Main St., Heppner, Ore.

Rainey, Marshall B.—Public health engineer, U.S. Public Health Service, PO Box 334, Logan, Utah

Reinhardt, Lewis K.—Manager, B & C Steel Corp., Kearney, Nebr. (Mail) Box 32

Sanderson, Leon F.—Graduate research assistant in agricultural engineering, Michigan State University, East Lansing, Mich. (Mail) 1960 Lake Lansing Rd.

Schlueter, Francis E. — Student in agricultural engineering, Iowa State College. (Mail) Ryan, Iowa

Schmale, William O.—Student in agricultural engineering, Alabama Polytechnic Institute. (Mail) RR 5, Cullman, Ala.

Smerdon, Ernest T.—Graduate assistant in agricultural engineering, University of Missouri, Columbia, Mo.

Smith, Lloyd T.—Manager, competitive analysis dept., Tractor & Implement Div., Ford Motor Co., 2500 E. Maple Rd., Birmingham, Mich.

Staff, Charles E. — Technical assistant to vice-president, Bakelite Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

Tellson, J. William—Sales engineer, Hyatt Bearings Div., General Motors Corp., 332 S. Michigan Ave., Chicago 4, Ill.

Turner, Wright E.—Research engineer, research div., Butler Mfg. Co., 7400 E. 13th St., Kansas City, Mo.

VandenBerg, Glen E. — Graduate research assistant in agricultural engineering, Michigan State University, East Lansing, Mich.

Weiland, Gerald E. — Welding engineer, Lincoln Electric Co., Seattle, Wash. (Mail) 602 W. 185 St.

Woods, Edgar H.—Vice-president and general manager, John Deere Plow Co. (Mail) 2524 Kirk Ave., Baltimore 18, Maryland

Transfer of Membership

Alpers, Robert J. — Sales engineer, The Michigan Vitrified Tile Co. (Mail) 114 N. Howell St., Owosso, Mich. (Associate Member to Member)

Brazelton, Robert W. — Design engineer, Blackwelder Mfg. Co., Rio Vista, Calif. (Mail) Box 674. (Associate Member to Member)

Haslett, Jr., Glenn M. — Partner, H & W Engineering Co., Indianola, Miss. (Mail) 705 Chapman St. (Associate Member to Member)

Letters to the Editor

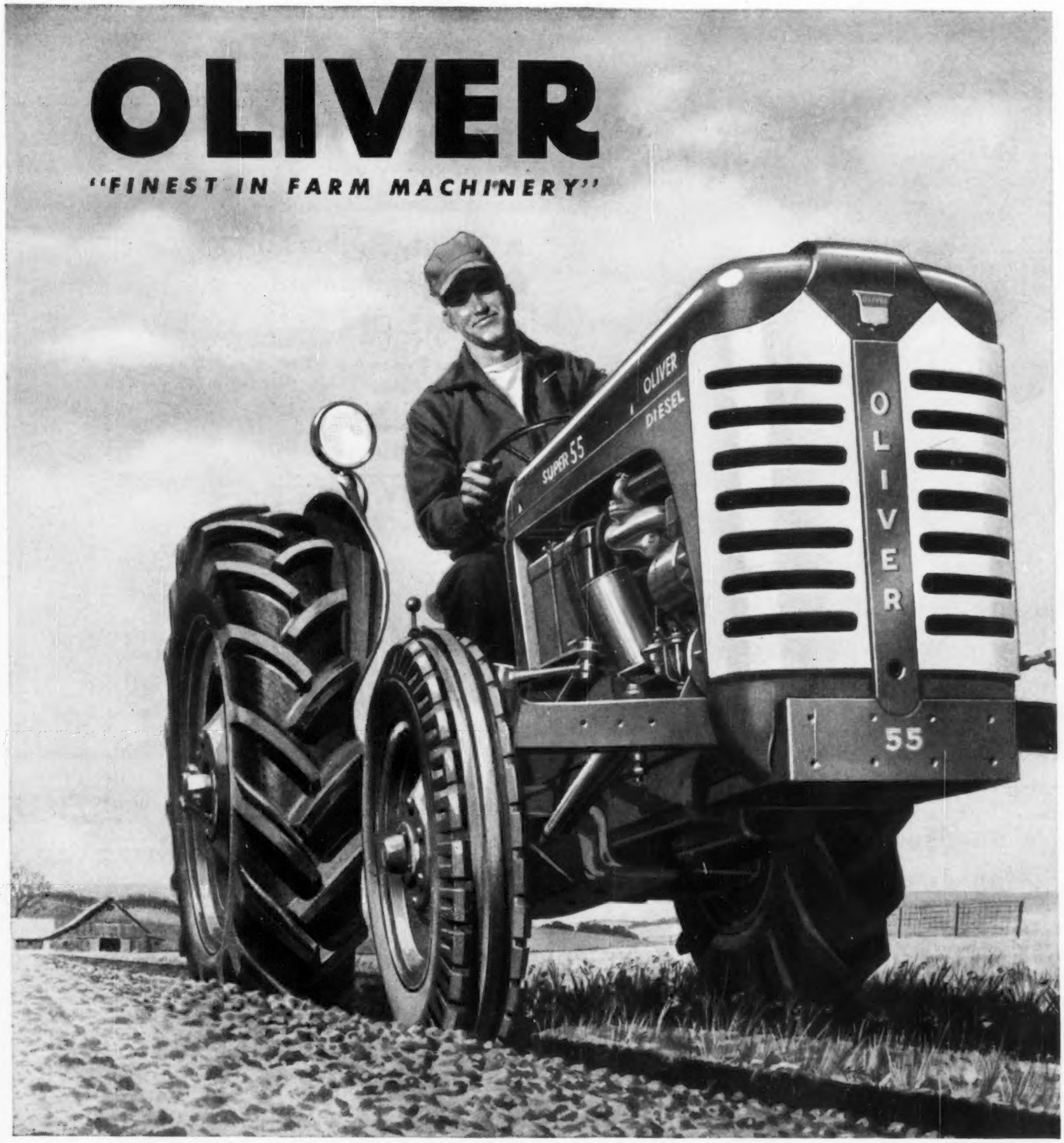
(Continued from page 48)

seed drill of five spouts and built on a cultivator for furrow opening.

India is only beginning to realize the need for improving her agricultural implements. The situation does not lend itself to widespread mechanization with tractors, though some are being sold. The community development project and national extension service blocks which have been set up and partly financed by Point Four and Ford Foundation funds, are greatly increasing the interest in improved implements, and I expect a large changeover in the next few years from the ancient wooden implements to more modern ones, though still largely animal powered. There is considerable scope for application of power to such things as silage cutting, threshing, and water pumping.

Mason Vaugh

Professor of agricultural engineering
Allahabad Agricultural Institute,
District Allahabad, India



The Oliver Super 55 Diesel Tractor, two-three plow capacity. Other Oliver Diesels in larger sizes.

you save 2/3

...yes, you can put as much as two-thirds of your present tractor fuel bills back in your pocket if you switch to an Oliver Diesel Tractor. Oliver Diesels use lower cost diesel fuel and give you more horsepower-hours per gallon. It averages out at about a two-thirds saving, depending on local fuel prices.

Only Oliver can supply you with diesel power in any farm tractor size; and Oliver Diesel Tractors use no special starting fuels, no extra starting equipment. Touch the starter button and you are ready to work.

The over-all design of Oliver Diesels will please you. Some tractors have some Oliver features—no other tractor has all of them. See your Oliver dealer or write for full information to

The Oliver Corporation,
400 West Madison St.,
Chicago 6, Illinois.

OLIVER

LOWEST COST high quality spreader ever offered

GRAND CHAMPION SPREADER VALUE

The NEW NEW IDEA No. 18

It's here! The lowest cost, high quality spreader in the NEW IDEA line. The new No. 18, 70 bushel capacity spreader has 12 "brand new" features plus the many features that have made NEW IDEA today's top spreader value. The spreader that is used by more farmers than any other make.

NEW IDEA dealers not only offer in this new No. 18 spreader high quality at lowest cost, but they can back it up with a full year guarantee that covers any repair parts replacements for one full year. (The guarantee is shipped with the spreader.) An advantage that makes it easier and easier to nose out competition on spreader sales.

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9. Slanted rear arch
10. Stronger A-frame hitch
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NEW IDEA

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Curry W. Stoup
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BIG 70 bu. capacity

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